Bio-Data

1. **Name** : **Dr. M. Jayachandran**

2. **Date of Birth** : **04-02-1954**

3. **Current position and address** : Chief Scientist
Head
Electrochemical Materials Science Division
CSIR-Central Electrochemical Research Institute
Karaikudi – 630 006, India

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4. Educational Qualifications :

Degree	Subject / Specialization	Year	University	Class
Ph.D.,	Industrial Chemistry	2002	Madurai Kamaraj University, Madurai	Commendable
M.Sc.,	Physics	1976	Annamalai University, Chidambaram	First
B.Sc.,	Physics	1974 (First Prize)	Madurai Kamaraj University, Madurai	First

5. Chronological career progression details:

Sl. No	From	To	Name of Organization	Position held
1.	1983	1988	CSIR - CECRI, Karaikudi	Scientist – B
2.	1988	1993	CSIR - CECRI, Karaikudi	Scientist – C
3.	1993	1998	CSIR - CECRI, Karaikudi	Scientist – EI
4.	1998	2003	CSIR - CECRI, Karaikudi	Scientist – EII
5.	2003	2009	CSIR - CECRI, Karaikudi	Scientist – F
6.	2009	Till date	CSIR - CECRI, Karaikudi	Chief Scientist

6. Total Research Experience/Area of Specialization (ANNEXURE-1)

6(a). Research Experience

- 39 years R&D (Research and development) experience in the field of electrochemical science and technology and Materials Science at CSIR-CECRI, Karaikudi. Classified into three major areas of Research .

6(b). Field of specialisation

- Research experience in Physical Chemistry, Electrochemical Materials Science & Nanotechnology.
- Preparation of nano crystalline metal oxide and composite powders/films using Electrochemical, chemical, sol-gel and combustion synthesis routes for gas sensors and catalysis for waste effluent treatment.
- Deposition of metal oxide thin films using various physical, vacuum and sputtering, electro chemical, pulsed laser techniques useful for solid state, Photo Electrochemical and dye sensitized solar cells.
- Characterization of physical and Chemical, Electrochemical properties of Nano semiconductor powders/hard coatings/metal oxide films (XRD, TEM, XPS, AFM, SEM, FTIR, Raman shift, NMR, ESR, Uv-Vis, Electrochemical impedance characterization techniques).
- Societal Mission Solar Energy projects: Solar Street lights in villages, Solar power plants, Awareness programmes

7. Research and Development Activities

7(a). Research Publications and Patents (Details given in Annexures separately)

Research Papers in International SCI Journals/National/Scopus	: **220**	**Annexure– II**
Papers presented in Conference/Published in Proceedings	: **68**	**Annexure– III**
Honors, Awards, Fellowship, Editorship received	: **28**	**Annexure– IV**
National /International events organized as Co-ordinator / National Organizing Committee Member	: **09**	**Annexure– V**

7(b). Graduation/Inaugural/Validictory Addresses, Invited talk / Plenary Lectures delivered

Talks on Solar Energy / Nano materials/devices/Hard coatings /Thin film and preparation techniques/characterisation techniques/addresses in Engineering/Arts & Science colleges/Universities : **65**

7(c). Dissertations supervised — Total: 101

M.Phil.,(Physics)	: **37**
M.Sc., (Physics)	: **23**
M.Sc., (Chemistry)	: **07**
M.Sc.,(Industrial chemistry)	: **01**
M.Sc., (Materials Science & Technology)	: **09**
M.Tech., (Electronics)	: **01**
M.Tech., (Nanoscience)	: **04**
M.Tech., (Mechanical)	: **02**
B.Tech., (Chemical & Electrochemical Engineering)	: **04**
M.E. (Materials Science)	: **01**
B.E. (Bachelor of Engineering) EIE, IT, CSE	: **12**

8. Contribution to CFE (B.Tech course) CECRI, AcSIR, Academic Institutions

8(a). Contribution to CFE (B.Tech course) CECRI, AcSIR

Handled Physics Classes and Labs.

8(b). Contribution as Board of studies member/Ph.D. evaluation in academic institutions (Science/Engineering Colleges and Universities of Tamilnadu)

Sl.No.	Year	Role	Institution
1.	2015-2013	Member	Board of Adjudicators for Ph.D., and M.Phil.,Avinashilingam University for Women, Coimbatore
2.	2014-2010	Member	Board of Adjudicators for Ph.D., Thiruvananthapuram, University of Kerala, Kerala
3.	2015-2013	Member	Acadamic Council, Sethu Institute of Technology, Kariapatti, Madurai, Tamilnadu
4.	2013-2010	Member	Ph.D. evaluation committee, Bharathiyar University, Coimbatore, Tamilnadu
5.	2012	Member	Ph.D. evaluation committee, Madurai Kamaraj University, Madurai, Tamilnadu
6.	2011	Member	Ph.D. evaluation committee. Anna University of Technology, Thiruchirapalli, Tamilnadu
7.	2012-2011	Member	Research Advisory Committee, Sethu Institute of Technology, Kariapatti, Madurai, Tamilnadu
8.	2009-2008	Member	Board of studies, Sri Nandhanam college of Engineering, Tiruppatur, Tamilnadu.
9.	2008 – 2006	Member	Board of studies, M.Sc (Post Graduate) Physics, Bishop Heber College, Trichy, Tamilnadu.
10.	2006 – 2005	Member	Board of studies, B.Tech. (Bachelor of Technology) School of Engineering and Technology, Bharathidasan University, Trichy, Tamilnadu.
11.	2006 – 2004	Member	Board of studies, M.Sc (Post Graduate) Materials Science & Technology, Thiagarajar College of Engineering, Madurai, Tamilnadu.
12.	2006 – 2004	Member	Board of studies, M.Sc (Post Graduate) Physics, Bishop Heber College, Trichy, Tamilnadu.
13.	2002 – 2000	Member	Board of studies, M.Sc (Post Graduate) Materials Science & Technology, Thiagarajar College of Engineering, Madurai, Tamilnadu.

9. Administrative/Organizational Contributions in CSIR-CECRI, Karaikudi.

9(a). Administrative Affiliation in CECRI

No.	Year	Role	Committee
1.	till date 2015-October 2014	Acting Director	
2.	2015-2012	Chairman	ERP implementation Committee
3.	March 2013-October 2012	Acting Director	
4.	2015 -2011	Member	CECRI Administrative collegium
5.	2015-2011	Chairman	Funding/Monitoring Start-up Projects for Young scientists/QHS/Inter divisional Projects
6.	2015-2011	Member	Empower Committee
7.	2014-2012	Member	Consultative Mechanism for redressal of the employees grievances at the Institute level
8.	2015-2001	Liaison Officer for OBC	CECRI, Karaikudi
9.	2013-2012	Chairman	CECRI Website validation Committee
10.	2013-2012	Chairman	Compassionate Appointment Committee
11.	2014-2012	Chairman	Guest House Management Committee
12.	2013-2012	Member	Lab Level Task Force Committee
13.	2013-2012	Chairman	Lab Level Implementation Team
14.	March 2013-October 2012	Vice-President	CECRI Staff Club
15.	2012-2011	Chairman	Outstanding Balance (OB) Clearance Committee
16.	2010-2009	Member	Local Grievances Committee
17.	2007-2004	Chairman	Dept. Canteen Management Committee, CECRI
18.	2005-2003	Member	Library Committee
19.	2004-2002	Member	Outstanding Balance (OB) Clearance Committee
20.	2000-1998	Secretary	CECRI Staff Club
21.	1999-1998	Member	CSIR Foundation day organizing Committee
22.	1988-1986	Secretary	Dept. Canteen Management Committee, CECRI

(9b). Contribution as Chairman/Nominee/Member in S&T Organizational Committees in CECRI, Karaikudi

1.	2015-2012	Chairman	140 kw Solar Power Plant Committee

2.	2013-2012	Directors' Nominee	Scientist Selection Committee, CECRI
3.	2013-2012	Chairman	Project Assistant Selection Committee
4.	2013-2012	Member	Medical Officer Selection Committee
5.	2013-2012	Chairman	Apprentice Selection Committee
6.	2013-2012	Chairman	Anti ragging Committee for Centre For Education (CFE)
7.	2011-2010	Member	Quick Hire Fellow Selection committee
8.	2010-2009	Member	Project Monitoring committee, CECRI
9.	2010-2009	Member	Prioritization committee for Procurement of Equipments,
10.	2010-2008	Member	Scientist Selection Committees (B,C & EI), CECRI
11.	2007	Member	Screening committee for recruitment & assessment promotion of scientists
12.	2007	Directors' Nominee	Assessment committee for Technical staff
13.	2007-1998	Member	Various Recruitment Committees for project staffs/ Apprentices
14.	2003-2000	Member	Deputation Committee for Seminars/Training/Foreign
15.	2002	Member	Committee to Prioritize In-house projects
16.	2002	Member	Assessment Committee for Group II Staff
17.	2002	Member	Selection Committee for LDC under casual workers absorption scheme of CSIR
18.	2002-1998	Member	Standing Committee for Technical Service
19.	2002-1998	Member	Stores Committee

10. Professional Membership in Scientific Societies

1.	2005	Life Member (LM – 122)	Electrochemical Society of India (ECSI), Bangalore, India
2.	2004	Life Member (LM – 48)	Indian Society for Electroanalytical Chem. (ISEAC), BARC, Mumbai.
3.	2003	Life Member (LM – 1096)	Instrument Society of India, Bangalore
4.	2000	Life Member (LM – 225)	Indian Thermal Analysis Society, BARC Mumbai.
5.	2000	Life Member (LM – B314)	Materials Research Society of India, Bangalore
6.	1997	Life Member (LM – 0727)	Solar Energy Society of India, New Delhi.
7.	1995	Life Member (LF – 412)	Society for Advancement of Electrochemical Science and Technology (SAEST), Karaikudi.

11. Total Career Profile:- Major Research Projects ongoing and completed

Funding received from

- Council of Scientific and Industrial Research (CSIR), New Delhi
- Board of Research in Nuclear Sciences (BRNS), Mumbai
- Department of Science and Technology (DST), New Delhi
- All India Council for Technical Education (AICTE), New Delhi

Presently involved R&D Ongoing projects:

11.1. CSC0134-CSIR- 12th FYP Project, New Delhi: Co- Investigator: Development of bioactive glassy metals coated implants and antimicrobial active immobilized fabrics for human healthcare (M2D), 2012 – 2017 (Rs. 1.66 Crores)

Objectives: To develop Zirconium based glassy metals of Zr–Cu–Ag–Al systems by reactive magnetron sputtering and Pulsed laser deposition which would be applied on the surfaces of bio medical implants made of stainless steel (AISI 316L), titanium and titanium alloys (Ti-6Al-4V) and to investigate the microstructural, mechanical properties. In vitro bio corrosion studies will be done using SVET, DC polarization and AC impedance. Biocompatibility will be evaluated by thrombogenecity and cytotoxicity studies. Synthesis of inorganic nano-particles and their nano-composites as anti-microbial agents to prevent undesirable effects such as degradation, staining and deterioration of fibers in textiles. A wide range of nanoparticles with various structures will be immobilized on the fibers, which will bring new and medicinal properties to the final textile product.

The following inorganic nano-structured anti-microbial agents will be studied: TiO_2 nano-particles, Metallic and non-metallic TiO_2 nano-composites, Titania nanotubes (TNTs), Zinc oxide nano-particles and nano-rods, Copper oxide nano-particles. Techniques such as sol-gel method, electrospinning, chemical and photocatalytic reduction process, sonochemical irradiation and magnetron sputtering will be used. The antibacterial activities of the nano-structured materials will be tested against Escherichia coli (Gram negative) and Staphylococcus aureus (Gram positive) cultures. $Zr_{48}Cu_{36}Al_8Ag_8$ (at.%) thin film metallic glasses were deposited on 316L stainless steel substrates by magnetron sputtering as thin homogeneous layers. Potentiodynamic polarization and AC impedance analysis in SBF showed that the as sputtered $Zr_{48}Cu_{36}Al_8Ag_8$ on 316L SS specimen had higher corrosion resistance without any localized pitting compared to the crystalline base alloy.

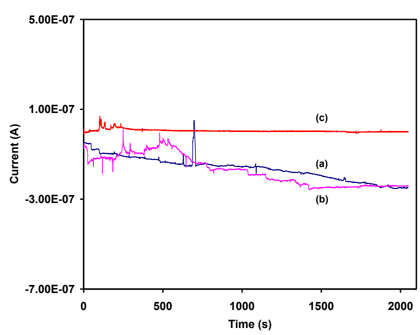
11.2. CSC 0101-12th FYP Project - CSIR- Network Project, New Delhi: Member with Corrosion Group: Corrosion and monitoring structures: Smart sensors and on-line monitoring (MULTIFUN), 2012 - 2017 (Rs. 2.00 Crores)

Metallic Oxide coated cylindrical and flat plate sensor electrodes have been prepared with various thickness. Their corrosion related parameters and sensing behavior in concrete structures will be studied. Sensors are to be embedded in concrete structures and multifunctional parameters such as half-cell potential, chloride level, resistivity, alkalinity and corrosion rate of reinforcements to be monitored. The integrated sensor along with online monitoring sensor platform to be the expected outcome of the project.

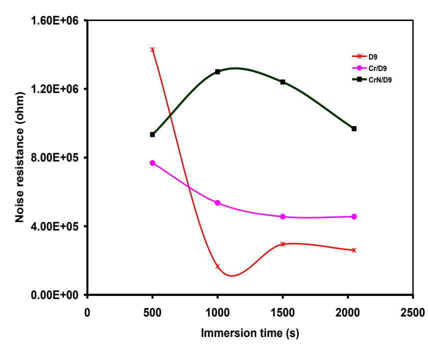
11.3. GAP–17/12-Department of Atomic Energy, BRNS, Mumbai: Co-Investigator :- Development of nanocomposite Ti-X-N (where X=B, Si, V, C and Cr) coatings by pulsed magnetron sputtering for multiple applications, **2012 – 2015. Rs. 23.908 Lakhs)**

The main objective is to prepare the transition metal nitride composite coatings such as Ti–X–N (where X=B, Si, V, C and Cr) by reactive pulsed magnetron sputtering after optimizing the process parameters such as substrate temperature, pressure, power, Ar/N_2 flow rate variation etc. The structural properties of these coatings will be studied in detail. The mechanical strength of the coatings will be tested by measuring hardness, adhesion and abrasion wear. Scanning Vibrating Electrode Technique (SVET) will be used to investigate localized electrochemistry and corrosion phenomena Electrochemical Noise (EN) measurements Microstructure of the coatings will be studied before and after the corrosion tests.

Chromium nitride films were coated on D9 steel substrates by reactive DC magnetron sputtering process. The XRD pattern confirmed the grown films have polycrystalline nature and exhibited CrN and Cr_2N phases. The coated D9 steel showed higher charge transfer resistance values compared to bare substrate. The corrosion current density (I_{corr}) was found to decrease from 1.31 $\times 10^{-7}$A for bare substrate to 1.88 x 10^{-8} A for CrN coated D9 steel specimen. A decrease in the porosity value was noticed for coated substrate. The polarisation resistance was found to be higher for the coated specimens. From electrochemical noise analysis, the current transient was found to decrease with increasing the immersion time for CrN coated substrate and potential noise shifted to the positive direction. The noise resistance was found to be higher for coated specimen than bare substrate.



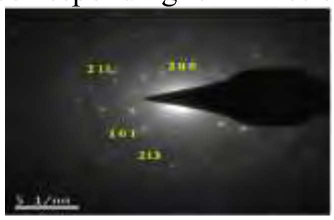
Current noise as a function of time of (a) D9 steel (b) Cr/D9 (c) CrN/D9.



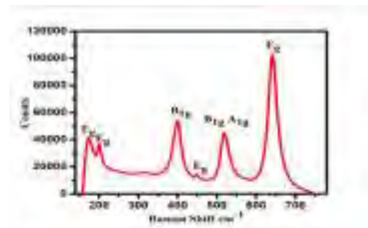
Noise resistance as a function of immersion time for the blank D9 steel, Cr/D9 and CrN/D9

11.4. GAP-03/12-MNRE-Network Project, New Delhi: Co Investi-gator:-Dye-Sensitize and Quantum Dot Sensitized Solar Cells (DSSC, QDSSC) (TAP-SUN), 2012-2017 (Rs. 2.036 Crores)

Optimization of the process parameters of titanium dioxide (TiO_2), Zinc Oxide using magnetron sputtering is performed. Titanium dioxide (TiO_2) thin films as block layers are prepared by DC reactive magnetron sputtering at a substrate temperature of 450°C. X-ray diffraction (XRD) and TEM-(SAED) analyses of the films reveal that they are polycrystalline in nature and have tetragonal structure with preferred orientation along the (101) direction. The presence of characteristic Raman peaks is observed along 173, 200, 400, 517, 640 cm^{-1} corresponding to anatase structure.



TEM-SAED Pattern of TiO_2



Raman spectrum for TiO_2 block layer

The surface morphological studies by FESEM, AFM reveal the uniform surface coverage of the grains on the surface of the films. An optical transmittance value of 80% in the visible light region with the optical band gap value of 3.2 eV is measured. These sputtered TiO_2 thin film is used as blocking layer over which thick layer of TiO_2 of about 10µm is prepared using TiO_2 paste and this stack is used as photoanode of DSSC cell. Electron beam evaporated platinum thin film on FTO coated glass substrate is used as counter electrode. The cell stack is shown below. The performance of the cell with an efficiency of 4.15% is achieved.

Representative DSSC stacks

The dye-sensitized photoelectrodes with block layers displayed improved V_{oc} and J_{sc} without lowering the FF, which improved the device performance. Studies are underway to further enhance the performance of DSSCs that include a compact nitrogen doped TiO_2 layer using newly developed working electrode, and a report will be forthcoming.

R&D/Consultancy Projects Completed

11.5.NWP–10-CSIR-Network Project, New Delhi:CECRI Co-ordinator: Development of Speciality inorganic materials for diverse applications, 2007 – 2012 (Rs.1.185 Crores)

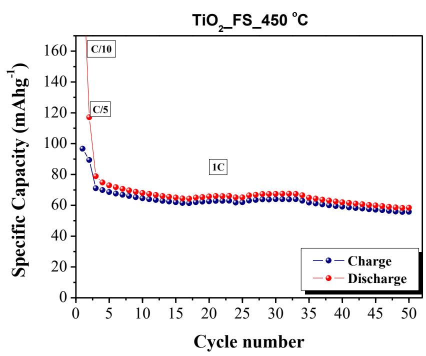
Oxide semiconductor thin films with nanostructure, as porous silicon matrix, transition metal oxides in thin film form and in powder were developed, through chemical routes. Various techniques such as RF sputtering, electron beam evaporation, electrochemical techniques, spray pyrolysis, were engaged for device development like; gas sensors, electrochromic windows, photoluminescent devices and batteries.

Important achievements:

Chemically stable and highly crystalline $MgIn_2O_4$ films was prepared using spray pyrolysis deposition technique on quartz substrate.Low resistivity NiO films, possessing anodic electrochromic properties, was deposited by the electron beam evaportation technique.Titanium nitride(TiN) films were deposited on AISI 316L stainless steel substrate by reactive magnetron sputtering using a Ti target. Corrosion resistance and hemocompatibility of TiN coated AISI 316L SS were studied for clinical applications.Deposition of nanocrystalline Indium TinOxide (ITO) was carried out using Radio frequency (RF) sputtering and spray pyrolysis technique.

Fabrication of Next generation TiO_2-Lithium ion batteries:

Recently TiO_2 based materials have also been demonstrated as potential anode material in rechargeable lithium ion batteries. TiO_2 has a lithium insertion voltage around 1.5 V which is far above the lithium plating voltage thus leading to safer lithium (/-ion) batteries when compared to carbonaceous materials. Also of importance TiO_2 is chemically stable, environmentally benign and low effective cost. By virtue of its exceptionally fast Li insertion and extraction kinetics, TiO_2- based materials (anatase) have drawn the research interest as anode materials for next-generation lithium ion batteries.



Charge- discharge curves of TiO_2 electrode at different conditions

The potential plateaus at 1.73 and 1.88V correspond to Li-ion insertion into and extraction from the interstitial octahedral sites of the TiO_2 nanotubes, and these Li ions are easily reversible. The lithium insertion/ extraction reaction in TiO_2 electrode can be written as

$$Li_xTiO_2 \leftrightarrow xLi^+ + x\,e^- + TiO_2$$

The maximum value of the insertion coefficient x has been determined to be about 0.5 that corresponds to a theoretical capacity of 167 mAh g^{-1}. Figure shows the charge- discharge curves of TiO_2 electrode at C/10, C/5 and C-rates.

11.6. GAP 19/08- DST project, New Delhi: Dy. Project Co-ordinator:- Development of Nanoscale Multilayered and nano composite super hard coatings by reactive magnetron sputtering for biomedical applications, 2009–2011 (Rs. 14.00 lakhs)

The structural, mechanical, corrosion properties and biocompatibility of TiN/TiAlN, TiN/NbN, TiN/VN multilayer and Ti-Si-N nanocomposite coatings prepared by reactive dc magnetron sputtering in an Ar-N_2 gas mixture was studied. Morphological study showed uniform coatings with columnar surface morphology.

The characteristic peaks were observed from Laser Raman spectrum of Ti-Si-N. The lower friction coefficient and wear rate observed for the multilayer coated sample indicated that the better wear resistance.

A maximum hardness value of 39GPa was observed for Ti-Si-N.Multilayer coatings and had better hemocompatability than single layer and bare AISI 316LSS substrates. The attachment of bacteria on multilayer coatings was found to be very minimum and without colonization. The multilayer coated 316L surfaces showed a significant reduction of the presence of bacteria, and this fact could probably be important in the decrease of the inflammation of the peri-implant soft tissues. It is concluded that by using the transition metal nitride based multilayer coated 316L SS as a human body implant, improvement of corrosion resistance as an indication of biocompatibility could be obtained.

11.7. GAP 19/06- Department of Atomic Energy, BRNS, Mumbai: Dy. Project Co-ordinator:-Development of Magnetron Sputtered Transition Metal nitride coatings (CrN, ZrN, AlN) and evaluation of their structural, mechanical and corrosion properties, 2006–2009) (Rs.13.39 Lakhs)

Hard coating of transition metal nitrides was developed by magnetron sputtering technique to have high mechanical strength and high corrosion resistance.

11.8. DU 10 OLP 0038-CSIR-Non-net work Project, New Delhi: *Member*:-Solar Battery- Research, Development and Demonstration of Prudent Lead-acid batteries for solar photovoltaic stand alone systems, 2005-2007 (Rs.25.00 Lakhs)

At present, solar lighting systems employ LMLA lead-acid batteries to store the electrical energy during daytime, which is retrieved on demand during night. These batteries have poor energy densities and are prone to sulphonation/stratification due to the large electrolyte volume. Besides, these batteries require periodic maintenance. Hence, new type of batteries like, VRLA-AGM, VRLA-GEL and Hybrid-AGM/GEL-VRLA batteries were assembled and tested with the objective to develop the most prudent maintenance-free solar lighting system.

11.9. SSP 11/05-Alagappa University, Karaikudi: Project Co-ordinator:- Spin coater- pulse console, 2005–2007,(Rs.3.5 lakhs)

Computer controlled spin coating unit and a pulse console was fabricated to make semiconductor thin films. Spin coater unit can be used for making oxide thin films using sol-gel precursors. Pulse console can be used to electrodeposit semiconductor films by using ON and OFF pulses of varying current density.

11.10.Task Force 1C-Net work Project, New Delhi: Group Co-ordinator: Development of different semiconductor nanoclusters like oxides, chalcogenides etc.,doped glassy films, 2002-2007 (Rs.85.00 Lakhs)

WO_3, MoO_3, SnO_2, In_2O_3 oxide films and their ternary compounds were prepared by the electrochemical, spray pyrolysis, vacuum evaporation and electron beam evaporation techniques for electrochromic devices and for use as transparent electrodes. Porous silicon (PSi) structure with nano Si pillars was formed on P-Si wafer by electrochemical route.

11.11.GAP 20/00)-DST project, New Delhi-Dy.Principal Investigator: Surface Chemistry and Electronic structure of impurity doped nanocrystals, 2001-2003 (Rs.8.88 Lakhs)

$SrAl_2O_4:Eu^{2+}$, Dy^{3+} phosphors were synthesized using the solid state reaction of Sr, Al, Eu and Dy carbonates/oxides taken in desired molar ratio.$ZnS:xMn^{2+}$ & $ZnS:xTb^{3+}$ nanoparticle powders were prepared by sol-gel and combustion synthesis routes.

11.12.GAP 02/00-AICTE project, New Delhi-Member:-Material Preparation and characterization of Cu and Cr substituted Mn spinels for lithium based batteries, 2000-2002 (Rs.9.00 Lakhs)

Copper, Chromium, cobalt and zinc substituted spinel were synthesized by solid state reaction and sol gel methods. The powders were characterized by XRD, FTIR, DTA, TGA, SEM and impedance studies.

11.13.GAP 15/96-DST project, New Delhi-Dy. Principal Investigator:- Fundamental and developmental studies on transparent oxide conductors, 1997-2000 (Rs.6.01 Lakhs)

$MgIn_2O_4$, $MgSnO_3$ and $MgSn_2O_4$ powders and thin films were prepared by different routes and their opto electronic properties were studied. Thin films of $MgIn_2O_4$ were also prepared by oxidizing evaporated Mg+In alloy.$MgIn_2O_4$ have been synthesized adopting different precursor routes by solid state reaction. Indates of Mg, Cd and Zn were synthesized both by solid state reaction route (SSR) and combustion synthesis. Zinc gallate was synthesized by SSR, Combustion synthesis (CS) and sol-gel routes. Monophase powders could be obtained only by SSR and CS only. $ZnGa_2O_4$ and $MgIn_2O_4$ have very high potentiality as transparent conducting oxide materials in electronic industries

11.14.SSP 12/99-AICTE Collaborative project with Alagappa University, Karaikudi Dy.Principal Collaborator–Material preparation and characterization of layered semiconductor thin film for solar cells, 1999-2000 (Rs.2.45 Lakhs)

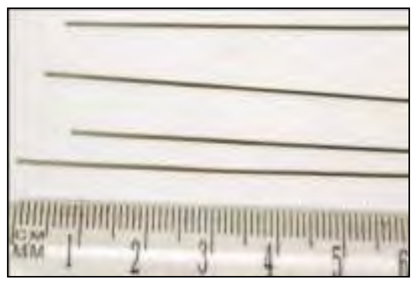
Principal Collaborator :- (CNP 0999) (Rs.0.90 Lakhs)

Sn (S, Se) is a layered compound semiconductor. It is also a very good material for solar energy conversion. These materials were prepared in the form of thin film through electrodeposition techniques.

11.15. CNP 05/11–"Advice on Sputter Coating of Titanium Nitride onto Nickel or Chrome Plated Stainless Steel Needles" to Nano Marker's Trichy, 2012 (Rs.1.08 Lakhs)

In this consultancy work, initially we did some feasibility studies on sputter coating of Titanium Nitride on needles and blades made of stainless steel and mild steel by optimizing the process parameters. After the satisfactory results, we have advised Nano Marker's Trichy to purchase DC Magnetron sputtering facility with the complete required specifications. A DC magnetron sputtering equipment with a 4" dia cathode assembly was purchased from VR Technologies, Bangalore and installed it at Nano Marker's Trichy. We performed few experiments in front of the client and trained them. Thereafter, we have made few visits to their company and discussed with them on the results of the experiments. They are advised to use the equipment for doing other coatings such as Silver, Sn, Chromium, Copper and Brass. It is understood from the discussion that they are able to fabricate successfully these coatings now. The work has been completed to the satisfaction of the client. The photographs of the products are shown here.

TiN coated needles



TiN coated blades

12. Societal Mission Projects received from Government of Tamilnadu for Non-Conventional Energy and Popularization

Conducted awareness program on utilization of solar energy. Solar lighting systems were installed in many villages of Ramanathapuram, Pudukottai and Sivaganga districts. Hands- on training and motivation programs were conducted for panchayat officials, village people, and students from schools, polytechnic and engineering colleges.

12.1. SSP 20/01-Solar Project, TN State Govt.–Project Co-ordinator: Design, Fabrication and Installation of Solar powered street lights in village panchayats of Pudukkottai Districts, 2002 - 2005, (Rs.14.26 Lakhs)

Solar street lighting systems have been installed in various panchayats. Training was given to the village youths and women in the self help groups for the maintenance of batteries, solar panel and control systems. Non-conventional energy awareness programs were conducted for the village people, students and panchayat officials.

12.2. SSP 06/06-TN State Government Project: Project Co-ordinator: Installation of solar lighting systems and conducting hands-on training programmes for village youths and women self help groups of Sivaganga Dt. 2006–2008, (Rs.1.40 Lakhs)

Solar street lighting systems have been installed in Aranmanaippatti panchayat. Training will be given to the village youths and women in the self help groups for the maintenance of batteries, solar panel and control systems. Non-conventional awareness programs will be conducted for the village people, students and panchayat officials.

12.3. CNP 0108-TN State Government Project: Project Co-ordinator: Installation of solar street lights to Anna Marumalarchi Thittam in villages in Ramnad district, Practical classes and maintenance, 2001-2003 (Rs.5.952 Lakhs)

Solar street lighting systems have been installed in various panchayats of Ramnad District. Training was given to the village youths and women in the self help groups for the maintenance of batteries, solar panel and control systems.

12.4. CNP 0136-TN State Government Project:Project Co-ordinator:- Installation of solar lamp systems in Collector's Camp Office at Pudukkottai, maintenance & providing training, 2002-2003, (Rs.1.55 Lakhs)

Solar street lighting systems have been installed in Collector's Camp Office at Pudukkottai.

12.5. SSP 06/03-TN State Government Project:Project Co-ordinator:- Design, Fabrication and Installation of Solar street lights and home lighting systems in woman sanitary complex and self help group buildings in the habitation of village panchayats in Pudukkottai District, 2003 – 2005, (Rs. 7.31 lakhs)

Solar street lights were installed in various villages and training programme for maintenance of batteries and solar panels.

12.6. CNP 0130-TN State Government Project: Project Co-ordinator:- Fabrication and installation of solar street lights to Singuvalaikurichi village in Ramnad district, Training & maintenance, 2002 – 2003 (Rs.0.93 Lakh)

Solar street lighting systems were installed in Singuvalaikurichi village in Ramnad district. Training was given to the village youths and women in the self help groups for the maintenance of batteries, solar panel and control systems. Non-conventional energy awareness programs were conducted in the Village.

12.7. GAP 13/03-Skill Development Training programme, Department of Science & Technology: Co-ordinator:- 2005- 2006 (Rs.2.00 Lakhs)

Training programme are trained for the un-employed women and men for repair of cell phones, TVs, CVDs etc so that they can be self-employed to earn their living.

13. List of Fifteen Best papers published in last 5 years

1. Organic Free Low Temperature direct Synthesis of Hierarchical Protonated layered Titanates/anatase TiO_2 hollow spheres and their task specific applications, Narottam Sutradhar, Sandip Kumar Pahari, **Muthirulandi Jayachandran**, A Manuel stephan, J.R.Nair, Balasubramanian Subramanian, Hari.C.Bajaj, Haresh M, Journal of Materials Chemistry A1 (2013) 9122-9131
2. CeO_2 nanowires with high aspect ratio and excellent catalytic activity for selective oxidation of styrene by molecular oxygen, Provas Pal, Sandip Kumar Pahari, Apurba Sinhamahapatra, **Muthirulandi Jayachandran**, G.V. Manohar Kiruthika, Hari C. Bajaj, Asit Baran Panda, RSC Advances 3(2013) 10837-10847.
3. Suitability evaluation of plasma ion beam sputtered TiN/TiOxNy multilayers on steel for bio implants, B. Subramanian, R. Ananthakumar, S. Yugeswaran,**M. Jayachandran**, M. Takahashi, Akira Kobayashi., Vacuum 88 (2013) 108-113
4. Facile fabrication of dye-sensitized solar cells utilizing carbon nanotubes grown over 2D hexagonal bimetallic ordered mesoporous materials, J. Balamurugan, Thangamuthu, A.Pandurangan, **M.Jayachandran,** J.Power Sources 225 (2013) 364-373.
5. Shape-selective synthesis of non-micellar cobalt oxide (CoO) nanomaterials by microwave irradiations. Subrata Kundu, **M. Jayachandran,** J. Nanopart Res 15(4) (2013) 1-13
6. Fabrication of amorphous $Zr_{48}Cu_{36}Al_8Ag_8$ thin films by ion beam sputtering and their corrosion behavior in SBF for bio implants. B. Subramanian, S. Yugeswaran, Akira Kobayashi, **M.Jayachandran,** Journal of Alloys and Compounds 572(2013)163-169.
7. Formation of shape-selective magnetic cobalt oxide nanowires: environmental application in catalysis studies. Subrata Kundu, M. D. Mukadam, S. M. Yusuf,**M. Jayachandran,** Cryst. Eng Comm, 15 (2013) 482-497.
8. Fabrication of Catalytically active nanocrystalline samarium (Sm)-doped cerium oxide (CeO_2) thin films using electron beam evaporation. Subrata Kundu, Narottam Sutradhar, R. Thangamuthu, B. Subramanian,Asit Baran Panda, **M. Jayachandran,** J. Nanopart. Res 14 (2012) 1040
9. Bio synthesis of calcium hydroxyl apatite coating on sputtered Ti/TiN nano multi layers and their corrosion behavior in simulated bodily solution. B.Subramanian,P.Dhandapani, S.Maruthamuthu and **M.Jayachandran,** Journal of Biomat. Applications 26 (2012) 687-705
10. Nanocomposite Ti-Si-N coatings deposited by reactive dc Magnetron sputtering for biomedical applications. B.Subramanian, R.Ananthakumar, Akira Kobayashi and **M.Jayachandran.** J. American Ceramic Society 205 (2012) 5014.

11. Facile Low-Temperature Synthesis of Ceria and Samarium-Doped Ceria Nanoparticles and Catalytic Allylic Oxidation of Cyclohexene. Sutradhar, A.Sinhamahapatra, SK.Pahari, **M.Jayachandran,** B.Subramanian, HC.Bajaj, A.B.Panda., Journal of Physical Chemistry C 115 (2011) 7628–7637.
12. Structural and tribological properties of DC reactive magnetron sputtered titanium/titanium nitride (Ti/TiN) multilayered coatings. B. Subramanian, R.Ananthakumar,**M.Jayachandran,** Surface & Coatings Technology 205 (2011) 3485–3492
13. Review of material properties of (Mo/W)Se_2-layered compound semiconductors useful for photoelectrochemical solar cells. S.M.Delphine,**M.Jayachandran,** C.Sanjeeviraja., Current Applied Physics 11 (2011) 43-49
14. Magnesium Indium Oxide ($M_gIn_2O_4$)spinel thin films: chemical spray pyrolysis (CSP) growth and materials characterizations. A. Moses Ezhil Raj, G. Selvan, **M.Jayachandran**, C.Sanjeeviraja., J. of Colloid and Interface Science.328 (2008) 396-401
15. High temperature grown transition metal oxide thin films tuning physical properties by MeV N^+ -ion bombardment R.Sivakumar, C.Saneeviraja, **M.Jayachandran,** R.Gopalakrishnan, S.N.Sarangi, D.Paramanik, T.Som, J.Phys.D:Appl.Phys.41 (2008) art. No.125304 467 – 473.

14. Editor of National Workshop Books/Proceedings:

1. Principles and practice of Powder X-ray Diffraction (2005), SAEST, Karaikudi.
2. Thin film preparation and characterization techniques for energy conversion (2004), SAEST, Karikudi.
3. Income generation through solar energy utilization and corrosion prevention measures (2003), CECRI, Karaikudi.
4. Materials and characterization (1998), CECRI, Karaikudi.

15. List of Patents /Copyrights/ Processes

15.1. Patents:

1. Patent No. 184732 (540/DEL/91/19.6.1991): An improved process on the preparation of photoconductive cadmium sulphide powder useful for xerographic applications
2. Patent No. 186024 (07/DEL/93/28.1.1993): An improved process for the preparation of a novel semiconductor oxide powder useful for the preparation of a negative electrode for rechargeable batteries
3. Patent No. 186154 (335/DEL/93/31.3.1993) An improved process for the preparation of a novel semiconductor negative electrode for rechargeable batteries
4. Patent No. 189943 (161/DEL/94/14.12.1994): A process for the preparation of cadmium tin mixed oxide semiconductor powder
5. Patent No. NF/355/99/PAT/600/SIL Computer controlled pulse console for semiconductor plating

6. Patent filed (2005): Rechargeable dry cell using conducting polyaniline
7. Patents filed (2006): Process for the preparation of tin sulfo selenide semiconductor thin film electrodes useful for photo electrochemical (PEC) cells.
8. Patent filed (2011): A novel method of depositing corrosion resistant metal nitride hard coatings with nano particle strengthened nickel-based composite coatings as interlayer on steel substrates. (Ref No.0013NF2011)
9. Patent filed (2013): Porous Metal Oxide/Composite Anode Materials for High Energy Li-ion Battery Applications.(Ref.No. 0067NF2013)

15.2. Copyright:

10. Copy-right No. L-15706/96/12.8.96: Software package for performance optimization of solar cells and panels
11. Copy-right No.029/CR/2005/24.02.2006:Software package for development of virtual instrumentation for a PC based potentiostatic and galvanostatic unit.

15.3. Processes:

12. Process on Sputtering of metallic nitrides and metals on synthetic chemical stones for ornaments usage (2008).
13. Process on Sputter etching of Brass valves for bonding to rubber (2008).
14. Process for manufacturing PC based pulse console for semiconductor deposition (2001).

(M.Jayachandran)

ANNEXURE – I

Dr.M.Jayachandran
Chief Scientist & Head
Electrochemical Materials Science Division
My research contribution can be classified under three major fields as:

I) Energy conversion/Energy conservation Devices: Development of Transparent Conducting Oxide films

II) Materials for Environmental Pollution control and Gas sensors

III) Materials for Affordable Health Care: Self healing fabrics, Biomedical, Dental, Orthopedic implants

The details of the work done under the above fields are given below.

(I) Energy conversion/Energy conservation Devices: Development of Transparent Conducting Oxide films

ITO film preparation by Sputtering technique

Deposition of nanocrystalline Indium Tin Oxide (ITO) using Radio frequency (RF) sputtering technique: ITO films were deposited on quartz substrates at room temperature using 13.56 MHz radio frequency magnetron sputtering system with 99.99% tin doped indium oxide (90:10 at%) ceramic target (5 cm diameter, 5 mm thickness) in argon atmosphere without the addition of oxygen. The RF power was varied between 50 and 350 W in steps of 50 W and the deposition was carried out for 20- 30 min. Film thickness was maintained in the range 450-500 nm by adjusting the time.

ITO films deposited at 200 – 250 W showed resistivity values of 10^{-2} – 10^{-3} ohm cm. The transmittance is about 85% in the visible region (**Fig.1**). Structural studies by XRDanalysis showed cubic bixtyite structure with In^{3+} and Sn^{4+} ions located at In_1 and In_2 octahedral sites and TEM analysis showed nano crystalline nature as shown in **Fig. 2**.

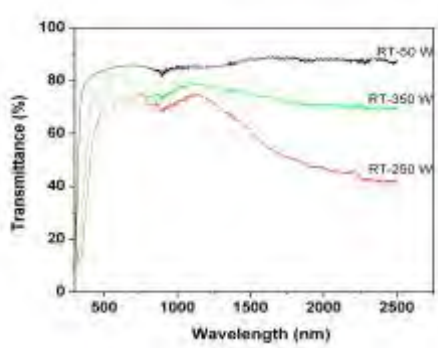


Fig.1. Transmission spectra of ITO films deposited at various RF powers

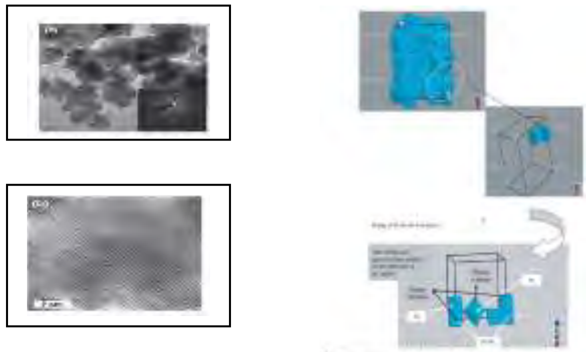


Fig.2. Schematic representation of doping of Sn into In_2O_3 matrix:a)In_2O_3 structure b)Sn-In_2O_3

ITO/ $MgIn_2O_4$ films by a Jet Nebulizer Spray (JNS) and Spray Pyrolysis technique

Nanocryastalline ITO thin films were deposited on glass substrates by a Novel and new spray pyrolysis route, Jet nebulizer spray (JNS) pyrolysis technique, for the first time at different substrate temperatures varying from 350 to 450°C using a precursor containing indium and tin solution with 90:10 at % concentration. The structural, optical and electrical properties have been investigated as a function of temperature. X-ray diffraction analysis showed that the deposited films were well crystallized and polycrystalline with cubic structure having (222) preferred orientation. The optical band gap values calculated from the transmittance spectra of all the ITO films showed a blue shift of the absorbance edge from 3.60 to 3.76 eV revealing the presence of nanocrystalline particles. AFM analysis showed uniform surface morphology with very low surface roughness values. XPS results showed the formation of ITO films with In^{3+} and Sn^{4+} states. SEM and TEM results showed the nanocrystalline nature with grain size about 12-15 nm and SAED pattern confirmed cubic structure of the ITO films (**Fig.3**). The electrical parameters like the resistivity, mobility and carrier concentration are found as 1.82×10^{-3} Ωcm, 8.94 cm^2/Vs and 4.72x1020 cm^{-3}, respectively for the ITO film deposited at 400°C. These results show that the ITO films, prepared using the new JNS pyrolysis technique, have the device quality optoelectronic properties useful for solar cells fabrication when deposited under the proposed conditions at 400°C.

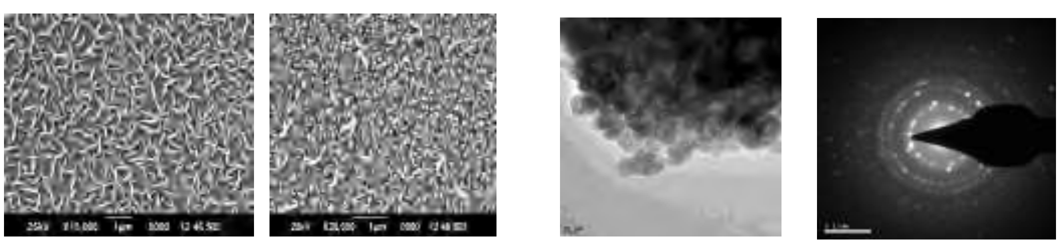


Fig. 3. SEM and TEM image and SAED pattern of ITO film deposited at 400°C.

$MgIn_2O_4$ films with 1:1 ratio of MgO:In_2O_3 in equal ratio have been already deposited by spray pyrolysis technique. XRD studies showed cubic structure **Fig.4**. It showed high resistivity values of about $10^{-1} – 10^{-2}$ ohm cm with transmittance of 70% in the visible region. Chemically stable and highly crystalline $MgIn_2O_4$ films have been prepared using spray pyrolysis deposition technique on quartz substrates.

The XRD studies revealed the cubic structure with a lattice constant of 0.88 nm which is very close to the standard value. The atomic ratio of magnesium and indium in the film is 0.46 which is nearly the same as present in the precursor (Mg/In = 0.5). Stoichiometric $MgIn_2O_4$ film shows an absorption edge at 310 nm corresponding to an optical band gap of 3.82 eV.

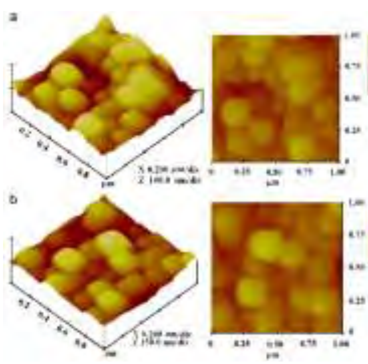


Fig.5. AFM micrographs of the $MgIn_2O_4$ films deposited at (a) 400 °C and (b) 450 °C.

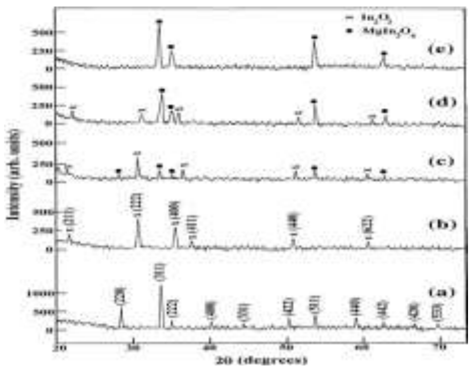


Fig. 4.XRD of (a)$MgIn_2O_4$ powder sample (b) Mg/In=0.35 (c) 0.40 (d) 0.45 (e) 0.50.

AFM image (**Fig.5**) shows a pore-free morphology with spherical grains of uniform size distributed all over the surface. From the observed electrical, optical and surface morphological properties, it can be concluded that the magnesium indium oxide films fabricated by the chemical spray pyrolysis technique under the optimized conditions are suitable for opto-electronic applications.

Low resistivity NiO films, possessing anodic electrochromic properties, have been deposited by the electron beam evaporation technique. The less crystalline NiO film was changed to have highly crystalline nature with FCC structure, after annealing the film at 500 °C. Uniform surface morphology with fine grain structure was evident from AFM analysis. The anodic color change of the NiO film, from transparent to brown color, was observed by cyclic voltammetric studies (**Fig.6**), which exhibits its usefulness for Electrochromic device fabrication for energy conservation.

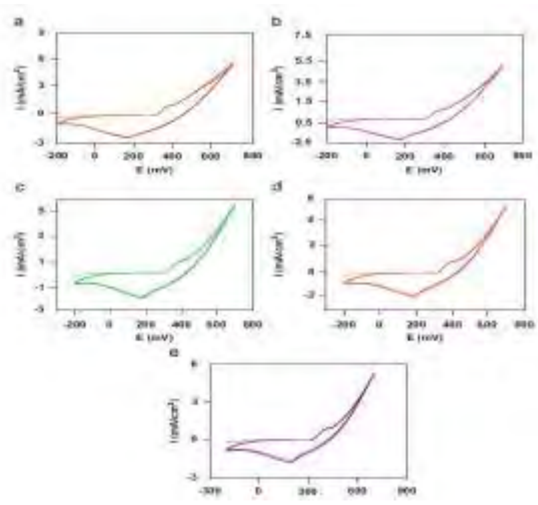


Fig.6. Cyclic voltammograms of NiO films for different cycles (a) 100 cycles (b) 200 cycles (c) 300 cycles (d) 400 cycles and (e) 500 cycles

ZnO and Ga doped ZnO films were deposited by pulsed laser deposition technique using KrF excimer laser wavelength of 248 nm and 300 mJ power. Wurtzite-Hexagonal structure was identified and photoluminescence studies confirmed Ga doping.

Nanocrystalline semiconductor oxide films as photoanodes in Dye Sensitized Solar Cells

Nanocrystalline ZnO thin films were potentiostatically electrodeposited at -1.0 V (vs Ag/AgCl) on transparent tin oxide conducting glass substrates in the presence of the ionic liquid (IL) 1-butyl-3-methylimidazolium methylsulfate, [bmim] [CH_3SO_4] and sodium dodecyl sulphate (SDS). X-ray diffraction and scanning electron microscopy studies of the deposited ZnO film confirm the presence of nanocrystalline morphology and stoichiometric ZnO with wurtzite structure. The observed strong photoluminescence peak in the Uv region at room temperature also confirmed the formation of ZnO films with nanograins. The large micellar formations by the complexation of $bmim^+$ with SDS anions provide a template for the formation of nanocrystalline ZnO films thereby the grain size of the deposited ZnO film is reduced from 85 to 28 nm. Therefore, addition of IL to the deposition bath containing a surfactant is a promising approach to achieve nanocrystalline as well as porous ZnO films with controlled morphology. It can be used as nanostructured transparent conducting electrodes for dye-sensitized solar cells (DSSC) (**Fig.7**) and as an efficient large surface area sensing element in hazardous gas sensors.

ZnO/dye electrode   Counter electrode

Fig.7. Simple fabrication of DSSC

Next generation TiO_2-lithium ion batteries for energy storage

Recently TiO_2 based materials have also been demonstrated as potential anode material in rechargeable lithium ion batteries. TiO_2 has a lithium insertion voltage around 1.5 V which is far above the lithium plating voltage thus leading to safer lithium (/-ion) batteries when compared to carbonaceous materials. Also of importance TiO_2 is chemically stable, environmentally benign and low effective cost. By virtue of its exceptionally fast Li insertion and extraction kinetics, TiO_2- based materials (anatase) have drawn the research interest as anode materials for next-generation lithium ion batteries.

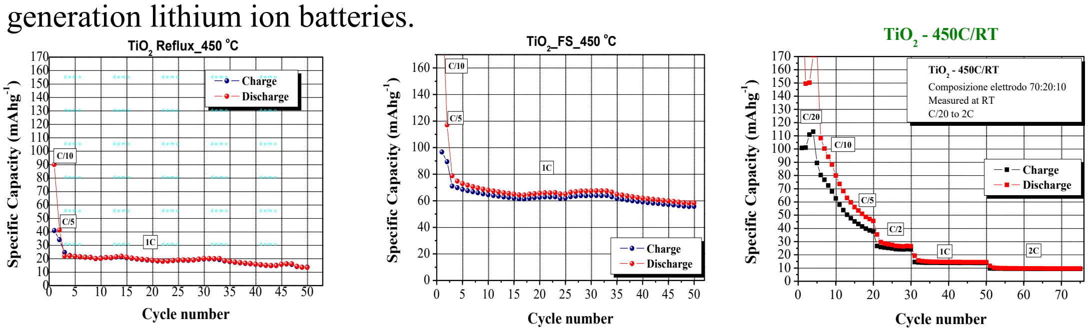


Fig.8. Charge- discharge curves of TiO_2 electrodes at different conditions

The potential plateaus at 1.73 and 1.88V correspond to Li-ion insertion into and extraction from the interstitial octahedral sites of the TiO_2 nanotubes, and these Li ions are easily reversible. The lithium insertion/ extraction reaction in TiO_2 electrode can be written as

$$Li_xTiO_2 \leftrightarrow xLi^+ + x\,e^- + TiO_2$$

The maximum value of the insertion coefficient x has been determined to be about 0.5 that corresponds to a theoretical capacity of 167 mAh g^{-1}. Fig.8 shows the charge- discharge curves of TiO_2 electrodes at C/20, C/10, C/5, C and 2C-rates synthesized at different conditions**.** The high rate cycling capability of lithium cells is one of the most important electrochemical characterizations which are required for high power storage applications.

(II) Materials for Environmental Pollution control and Gas sensors

Porous Silicon preparation by Electrochemical Anodization for Gas sensors

Non-anodized silicon wafer showed a very sharp peak at 2θ = 69.2° demonstrating its single crystalline (c-Si) nature. A PSi sample showed broader XRD peak depending on its porosity. A single peak at 2θ = 69.2° is observed corresponding to the (400) orientation of the p-type silicon (**Fig.9**). When the current density increased, the peak width (FWHM) was also increased. This is expected since higher current density produces PSi sample with higher porosity, hence smaller crystallite size.

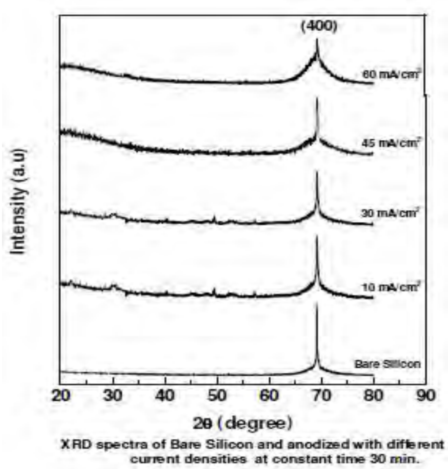


Fig.9

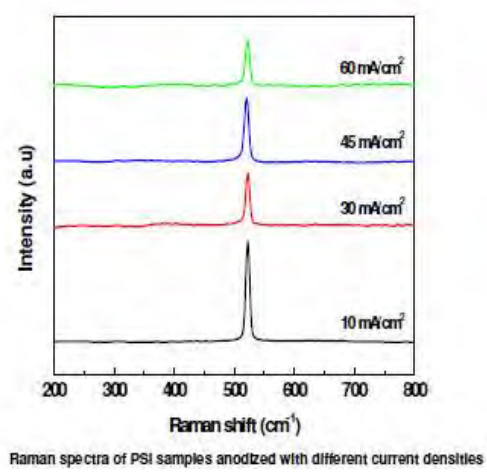


Fig.10

The Raman spectra for crystalline silicon consist of one sharp peak situated at 520.5 cm^{-1}. As the size of nanocrystal decreases, the silicon optical phonon line shifts to lower frequency and becomes broader asymmetrically (**Fig.10**). Photoluminesence shows very intense emission peak at around 638 nm (**Fig.11**). Intensity of the peak increases with increasing porosity due to increasing etching time and reduction in silicon nano crystal size. AFM picture shows porous and pillared Si surface morphology as shown in (**Fig.12).**

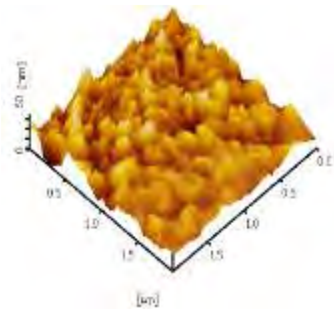


Fig.11. PL spectra of PSi structure

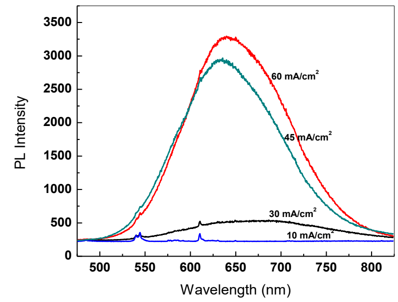


Fig.12. AFM surface of PSi

ZnO/PSi– Pulse Laser Deposition

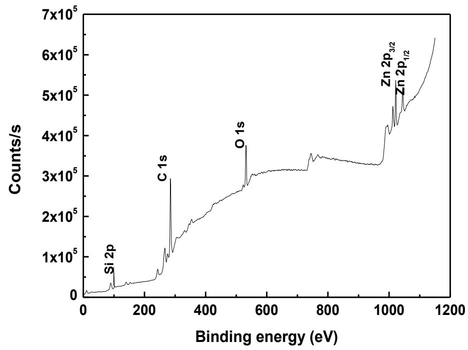


Fig.13. XPS spectra of ZnO/PSi films.

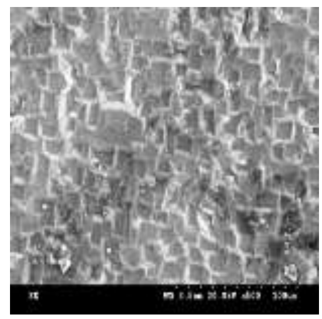


Fig.14. SEM pictures of ZnO/PSi films

XPS studies were conducted (**Fig.13**) on ZnO/PSi heterostructure. Zn 2p3/2 and Zn 2p1/2 peaks are located at 1021.7 and 1044.7 eV. O 1s and Si 2p1/2 peak positions are observed at 531.9 and 101.3 eV. From the SEM picture (**Fig.14**), it was obvious that the ZnO thin film was closely connected with the PSi substrate. These morphology makes porous silicon an adhesive surface for accommodating ZnO into its pores. ZnO thin film, prepared by PLD technique, acted as a transparent capping, providing a good coverage of the crystalline surface on the PSi surface, which could improve the structural stability of the PSi substrate.

PSi-ZnO by Pulse Electrodeposition

ZnO thin films were deposited on Porous silicon (PSi) by the Pulsed electrodeposition (PED) process, using Zinc nitrate as precursors and KNO_3 as supporting electrolyte. The Porous silicon substrates were formed by electrochemical anodization on p type (100) silicon wafer. The Raman Spectroscopy revealed that the good quality of the Porous silicon substrate. The Structure of the films was studied using XRD. The XRD analysis shows that the films have hexagonal crystal structure (Zincite). The surface morphologies were determined using Scanning electron microscopy (SEM) and the grain size of the ZnO is around 10 to 30nm (**Fig.15**). The appearance of Zn-O stretching mode at 456 cm^{-1} in FTIR spectra of these films confirmed the formation of ZnO. Optical measurements were made on samples deposited on ITO showing a band gap of 3.3.eV , refractive index of 2.004 and the film was found to have 80% of transmittance in the wavelength range of 400-2000 nm which is in agreement with the reported values of ZnO. This Psi-ZnO structure has large surface area and was tested as Gas sensing gadjet for sensing methanol/ethanol/NH_4 gases.

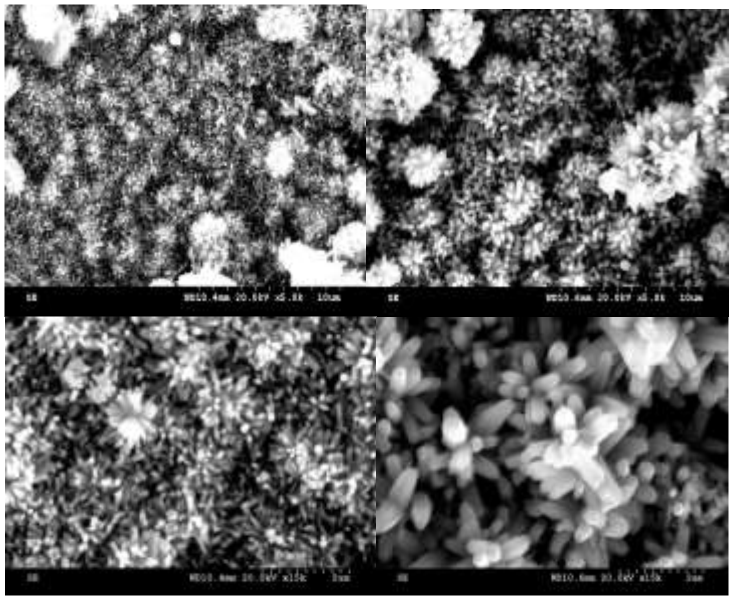


Fig.15. SEM images of the ZnO thin films on PSi by PED

CeO_2 thin films for Mineralization of Dyes in Chemical Industry

Thin Cerium oxide thin films (CeO_2) were prepared on different substrates by electron beam evaporation (EBE) technique. The CeO_2 thin films were post annealed at different temperature ranging from 100°C to 500°C in dry air for 1 hrs. The effect of annealing temperature on the structural and microstructural properties of CeO_2 thin films was studied using X-ray diffraction (XRD) **Fig.16**. The polycrystalline nature of the annealed CeO_2 films was identified and the structural parameters were calculated, from XRD pattern. Uniform surface coverage by fine grained morphology of annealed CeO_2 film was observed from AFM **Fig.17**. The band gap value (Eg) was found to be around 3.5 eV.

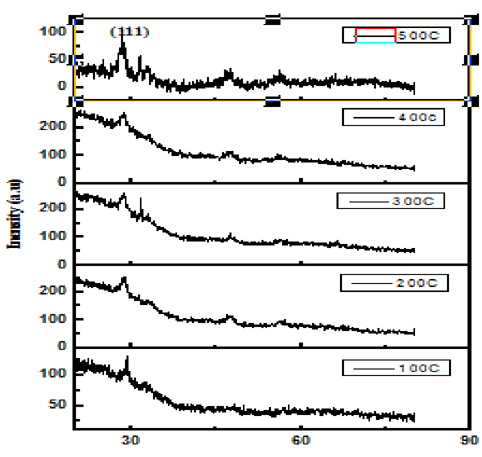


Fig.16. XRD of CeO_2 films.

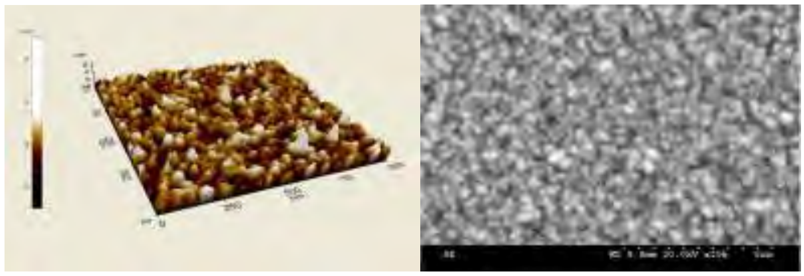


Fig.17. Surface morphology of CeO_2 films by AFM

Preparation of Samarium (Sm) doped Cerium Oxide (CeO_2) thin films for catalytic application

Sm doped CeO_2 thin films was fabricated by electron beam evaporation techniques. The optical property and other morphological studies were done by UV-Vis, XRD, XPS, SEM, EDS, and FT-IR analysis. XRD, XPS, and FT-IR analysis which clearly confirmed the presence of Sm in the ceria site (Fig.18). From the SEM study it was found that after annealing at high temperature (~300 °C or 500 °C), the particles size reduced due to breakdown of larger particles. This was matched with the results from UV-Vis, XRD, and XPS analyses. FT-IR study proves the presence of –COO-, -OH or ammonium group on the particles surface. The deposition of Sm doped CeO_2 nanomaterials was found more feasible on ITO substrate compared to glass in terms of stability and depth of film thickness. This present process might give an idea for the easy fabrication of other doped oxide materials with different morphology.

The fabricated Sm doped CeO_2 thin films show excellent catalytic activity for the reduction of different organic dye molecules in presence of $NaBH_4$ (**Fig.19**). The Sm doped CeO_2 nanomaterials participate during the electron transfer process from the BH_4^- ions to the oxidized form of the dye molecules. The synthesised thin films might find wide variety of applications like solid oxide fuel cells (SOFC), oxygen sensor or as catalyst in different organic and inorganic catalytic reactions. The fabrication process is very simple, straightforward, less time consuming, and cost effective.

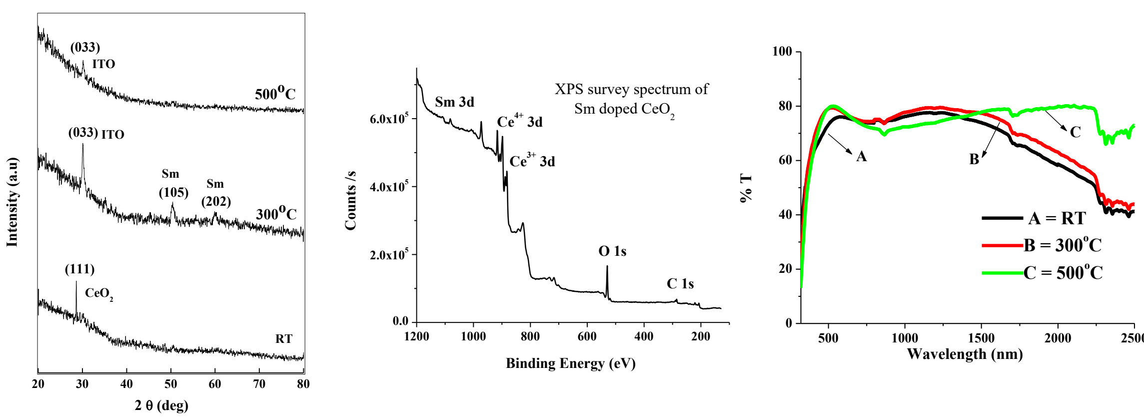


Fig. 18. Characterization of Sm doped CeO_2 thin films

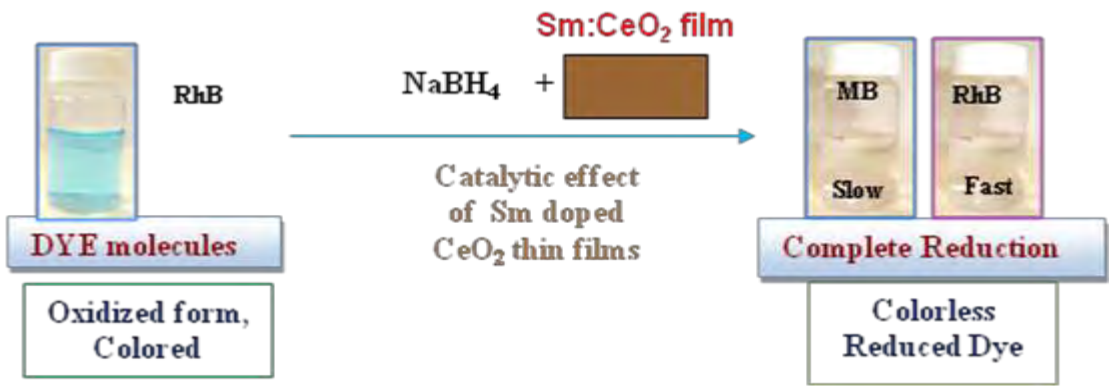


Fig. 19. Catalytic application of Sm-doped CeO_2 thin films

(III) Materials for Affordable Health Care: Self healing fabrics, Biomedical, Dental, Orthopedic implants

Titanium based Hard coatings for Biocompatible implants

Highly adherent and hard (Fig.20) TiN, TiAlN and TiO_xN_y coatings, as seen in the scratch test (**Fig. 20**), were deposited onto CP-Ti (Commercially Pure) substrates by DC reactive magnetron sputtering method using a combination of Ti, Ti-Al targets and an Ar-N_2 mixture discharge gas. The presence of different phases like TiN, TiAlN, Ti-Al-O-N and TiON were identified by XRD (Fig.21) XPS analyses. The XPS survey spectra on the etched surfaces of TiN film exhibited the characteristic Ti2p, N1s, O1s peaks at the corresponding binding energies 454.5, 397.0, and 530.6eV respectively.

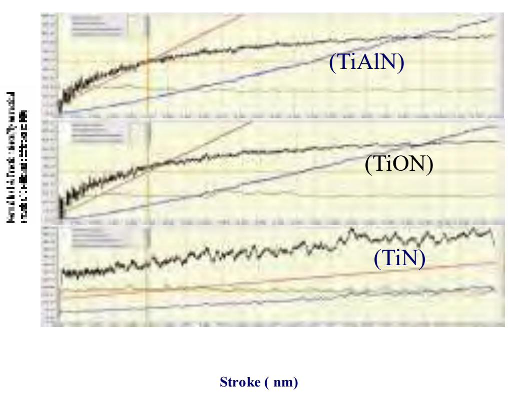


Fig.20 Scratch test on TiN, TiON and TiAlN

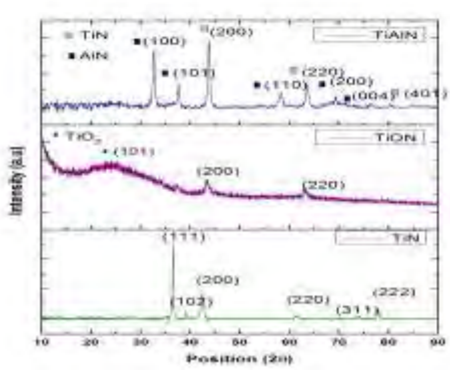


Fig.21 XRD pattern for TiN, TiON and TiAlN

The surface morphology and topography of these coatings were studied using scanning electron microscopy (SEM) and atomic force microscopy (AFM) respectively. The characteristic Raman peaks at 226, 544 cm^{-1} for the TiN film and at 249, 659cm^{-1} for the TiAlN film were observed from the Laser Raman spectrometer. The Potentiodynamic polarization studies in simulated bodily fluid were performed and the results showed superior corrosion resistance of TiON and TiAlN coated specimen over TiN coated specimen and bare CP-Ti substrates (**Fig. 22**).

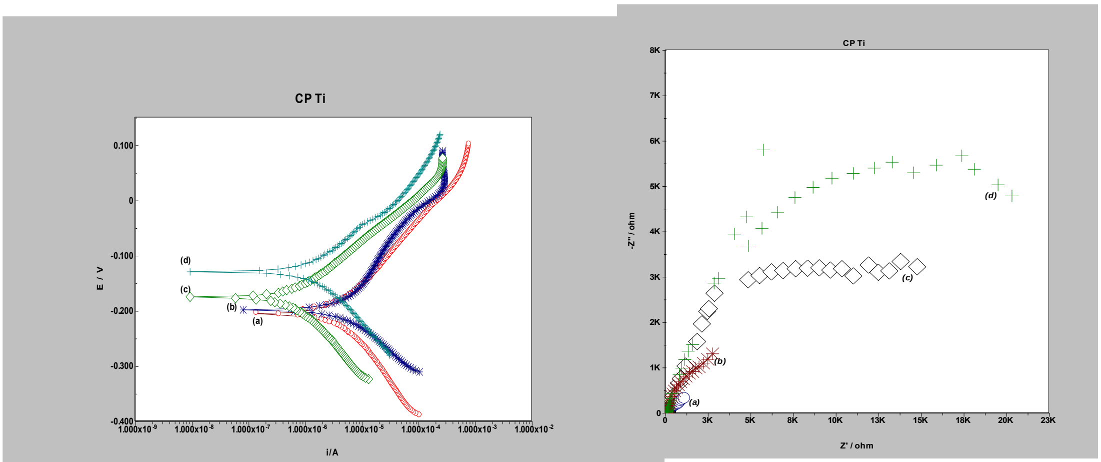


Fig.22. Potentiodynamic polarization and EIS analysis

Platelet adhesion experiments were done to examine the interaction between blood and the materials in vitro. On uncoated control samples (CP-Ti), platelets were seen as aggregates, whereas on coated samples, platelets were seen as singles, without any significant spreading. Cytocompatibility studies of coated samples were carried out with bare titanium (CP Ti – ASTM B 348) as controls. L-929 mouse fibroblast cells were used for analysis. It is found that the entire coated specimen was found to be noncytotoxic (**Fig.23**).

Fig.23. Fibroblasts with (a) Cp Ti (b)TiN

Biosynthesis of Calcium Hydroxylapatite Coating on Sputtered Ti/TiN NanoMultilayers and their Corrosion Behavior in Simulated Body Solution

Titanium/titanium nitride (Ti/TiN) nanoscale multilayered films were deposited onto 316L stainless steel substrates by reactive magnetron sputtering using a Ti target. Coatings characterized by X-ray diffraction showed that the stack possesses body centered cubic structure. The X-ray photoelectron spectroscopy survey spectra on the etched surfaces of the stack film on steel exhibited the characteristic Ti2p, N1s, and O1s peaks at the corresponding binding energies 454.5, 397.0, and 530.6 eV, respectively. Platelet adhesion experiments were carried out to examine the interaction between blood and these materials in vitro (**Fig. 24**).

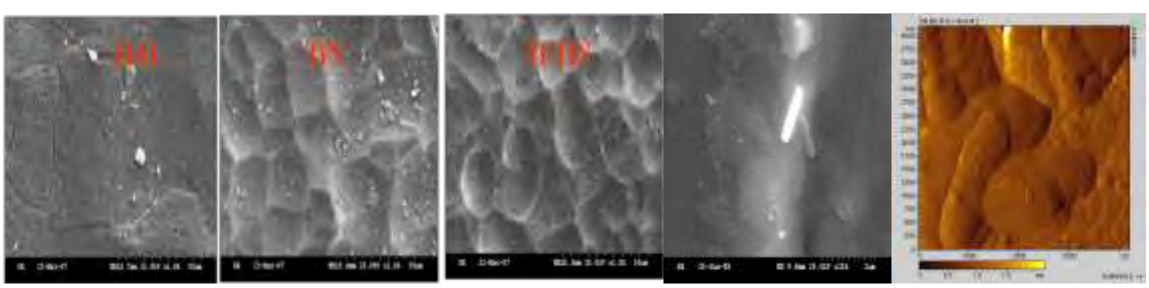


Fig. 24. SEM micrograph showing the morphology of the adherent blood platelets on the substrate, TiN coating, and Ti/TiN coating.

The results indicated that the smoothness and lower isoelectric point contribute to better hemocompatibility of the Ti/TiN nanoscale multilayered coating. The biomediated synthesis of calcium hydroxylapatite (HA) was carried out on coated substrates using calcium-depositing bacteria.

The observation of low corrosion current density (I_{corr}) for the calcium HA-coated Ti/TiN specimens in simulated body fluid confirmed their highly resistive nature under the testing condition.

Development of nanoscale multilayered and nanocomposite super hard coatings by reactive magnetron sputtering for biomedical applications

Studies on Properties of TiN/TiAlN

Structure, microstructure and compositional analysis

Typical X-ray diffraction pattern of single layer TiN (**Fig.25**.), TiAlN (**Fig.25.)** and TiN/TiAlN (**Fig.25.)** multilayered coatings deposited on steel substrate at substrate temperature of 400 °C is shown in **Fig.25**. TiN and TiAlN single layers are polycrystalline exhibiting diffraction peaks with the preferred orientation along (111) plane. Both TiN and TiAlN showed a single-phase fcc structure. It is noted that the cubic TiAlN B1 NaCl structure has the same bravais lattice (crystal structure) of the cubic TiN structure. The peak positions of TiAlN coatings are shifted to the higher angles with respect to TiN peaks owing to lattice constant decreases arise from the partial replacement of the titanium atoms in the TiN lattice by the aluminium. The TiN/TiAlN multilayer coating also exhibited the B1-NaCl crystal structure. Diffraction peaks of (111), (200), (220) and (222) for TiN and (111) (220) and (222) for TiAlN peaks respectively, were observed in the XRD pattern.

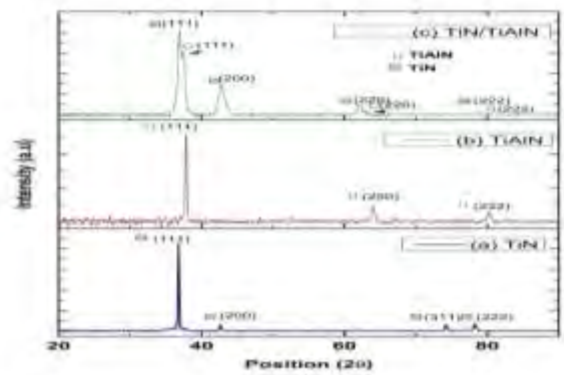


Fig.25 XRD patterns of TiN/TiAlN multilayers prepared by magnetron sputtering

The analysis of XPS survey spectra indicates that Ti, Al, N, O and C elements coexist in the deposited TiN/TiAlN films. The peak associated with Ti2p consists of two peaks centered at 457.7 (Ti 2p3/2) and 462.7 eV (2p1/2). Gauss fitting of Ti 2p3/2 peak indicated that it consisted of two peak centered at 456.1 and 457.9 eV which can be attributed to chemical bonds of TiON and TiO_2 respectively Moreover, the 2p1/2 envelopes are in 461.1 eV for TiN and 463.5 eV for TiO_2 compound.

The microstructure and morphology of the films have been observed by scanning electron microscopy (SEM), transmission electron microscope (TEM) and atomic force spectroscopy (AFM). **Figure 26a** presents the morphology of the coatings prepared at 400 °C. It can be seen that the film exhibits a cell-like surface appearance with an average grain size of about 60 nm. A close look at the micrograph indicates that the cells are composed of tiny grains. High resolution cross sectional TEM analysis (**Fig.26b**) showed the columnar growth of the coating. The polycrystalline diffraction pattern (**Fig.26c**) confirms the information provided by X-ray diffraction.

From **Fig.26d** the growth model of TiN/TiAlN multilayered coatings appears as the island growth. The growth orientation of grain shows uprightness to the substrate surface. The surface of TiN/TiAlN coatings is very smooth. The average RMS roughness value of 4.8 nm was observed.

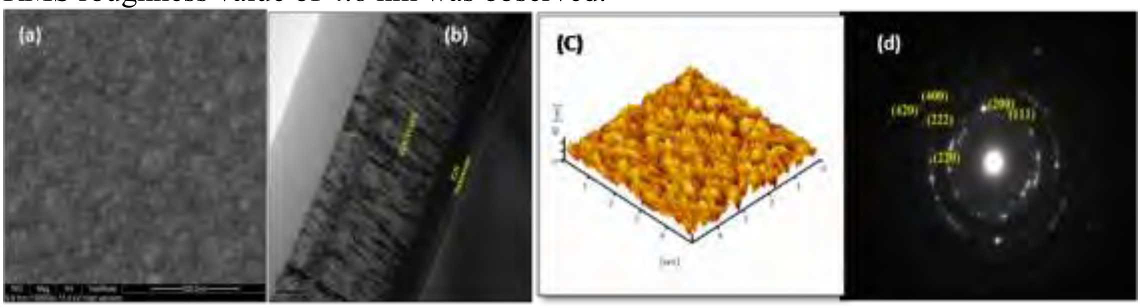


Fig.26 (a) FESEM image of TiN/TiAlN coatings (b) Cross sectional TEM image of TiN/TiAlN coatings (c) Typical 3D AFM image of TiN/TiAlN multilayered coatings (d) SAED pattern of TiN/TiAlN coatings

Wear and Electrochemical corrosion properties

The frictional behavior of the coatings under a normal load of 3.924 N at room temperature is shown in **Fig.27a.** Sliding friction for TiN/TiAlN coated films shows a relatively lower value of about 0.25 compared to the 0.40 and 0.45for the single layer coatings and bare substrate. TiN/TiAlN multilayered coatings show the lowest coefficient of friction compared to single layer and bare substrate. In **Fig.27b** a large difference can be seen in wear rate and found to be the lowest for the TiN/TiAlN multilayer coatings.

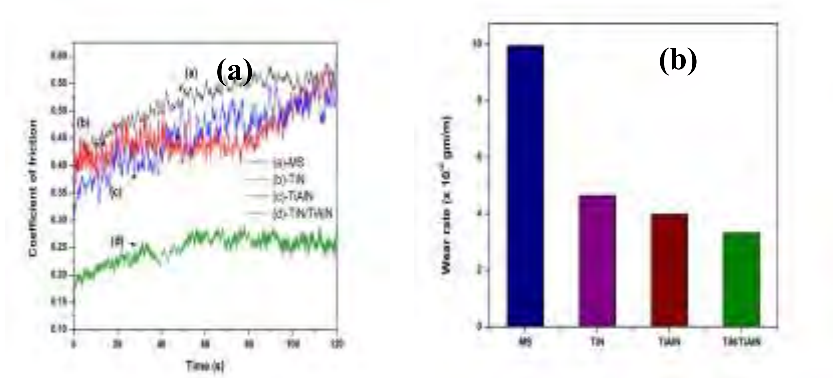


Fig.27 Friction coefficient of the TiN/TiAlN multilayer coatings and **(b)** Wear rate for TiN/TiAlN multilayer coatings.

XPS survey spectra of TiN/NbN multilayered coatings grown at 400°C indicated the presence of Ti, Nb, N, O and C characteristics lines and the corresponding binding energies are 458.2, 207.3, 396.6, 530.1 and 285.1eV respectively.

The X-ray diffraction pattern of as deposited TiN, NbN single layer and TiN/NbN multilayered coatings at substrate temperature of 400 °C is shown in **Fig.28.**

XRD analysis of the TiN coatings (**bottom**) showed the existence of cubic structure with (200) orientation. NbN coatings showed (**middle**) the hexagonal structure with (101) orientation. In the form of multilayer coatings (**top**) were crystallized in the cubic structure of TiN and hexagonal structure of NbN coatings. The d values of XRD reflections were compared with standard d values taken from JCPDS data file (NbN: 01-089-4757 and TiN: 03-065-0970).

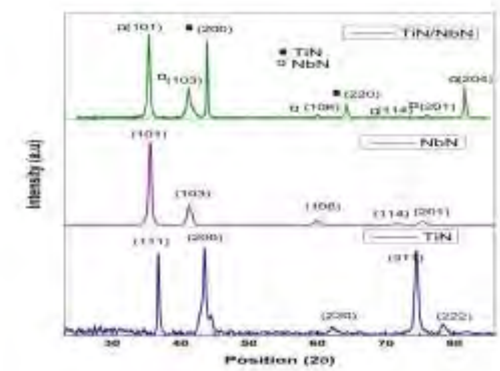


Fig.28. XRD patterns of TiN/NbN multilayer coatings prepared by magnetron sputtering.

The films have (200) and (101) preferential orientation for TiN and NbN layers respectively. There are six NbN and two TiN peaks appearing in the spectrum, which indicate the presence of both phase in this coating. Their crystal planes are (101), (103), (106), (114), (201) and (204) for NbN and (200) and (220) for TiN phase. The indexed pattern confirms the cubic structure for TiN and hexagonal structure for NbN. This result is in good agreement with the XRD.

Fig.29. shows the typical load vs. displacement for the 316L substrate, TiN, NbN single layer, and TiN/NbN multilayer coatings at a load of 5 mN. The area formed by the loading and the unloading curves, defined as plastic deformation work, can be used to assess the resistance of plastic deformation and the wear resistance of the multilayer coatings which exhibit the hardness anomaly.

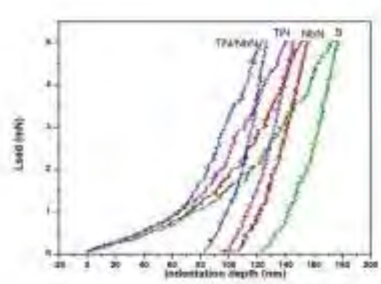


Fig.29. Load vs. displacement curve for multilayer coatings

The hardness of the coating, calculated from the load vs. displacement plot, was about 37 GPa for TiN/NbN multilayer coatings with an indentation depth of 120 nm. TiN and NbN single layer coatings deposited under similar conditions showed hardness of about 23 and 20 GPa, with an indentation depth of 142 and 150 nm respectively. A 316L stainless steel substrate showed a low hardness of about 12 GPa with maximum indentation depth of 175 nm. From this result, the TiN/NbN multilayer coatings showed the smallest plastic deformation work and the largest resistance to plastic deformation as compared to the TiN and NbN single layer coatings and the bare substrate.

Bacterial attachment studies

The bacterial adhesion onto implant surfaces is a critical issue in recent days. A bacterial adhesion to implant surfaces s a first stage of peri-implant muscositis and peri-implantitis; in fact, a positive correlation has been found between oral hygiene and marginal bone loss around implants in the edentulous mandible. The surface modification and the use of different materials have been shown to play a relevant role in the bacterial adhesion to implant surfaces. The present study has showed the significant difference exist in bacterial adhesion between TiN, NbN single layer, TiN/NbN multilayer coatings and bare AISI 316L substrate.

Properties of TiN/VN

Structural and compositional analysis

The X-ray diffraction patern of TiN/VN nanoscale multilayer coatings prepared by reactive dc magnetron sputtering is shown in **Figure.30.** The observed d values are in good agreement with the standard values with JCPDS card no 089-5265 for VN and 087-0633 for TiN coatings. They crystallized in cubic structure with lattice parameter of 4.16A° and the peaks corresponding to (111), (200), (220), (311) and (222) planes were observed.

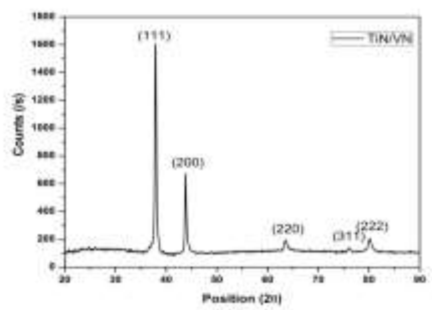


Fig.30. XRD patterns of TiN/VN multilayers prepared by magnetron sputtering.

Platelet adhesion test

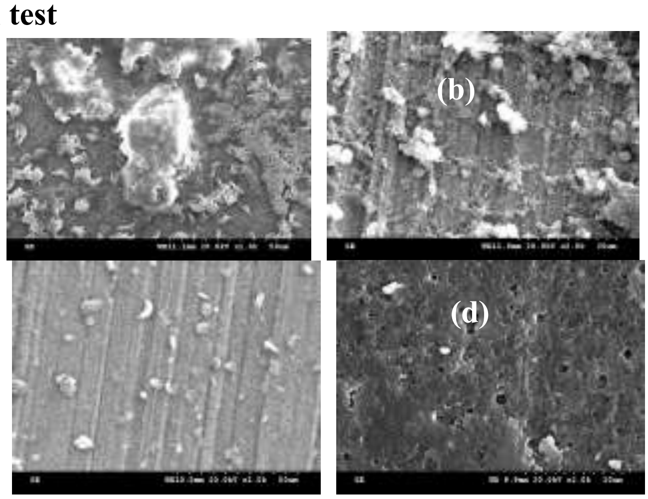


Fig.31 Morphology of platelet adherent on (a) Steel Substrate (b) TiN (c) VN and (d) TiN/VN multilayeres.

Fig.31 shows the morphology of the platelets adhering to the TiN/VN nanoscale multilayer, VN, TiN single layer coatings and on AISI 316LS substrates after incubation for 60 min. The number of adherent platelets on the surface of the TiN/VN multilayer, VN, TiN single layer coating exhibit fewer aggregation and pseudopodium compared to AISI 316LS substrates. **Fig.30** also indicates that adherent platelets on the TiN/VN multilayer coatings are even lesser than those on the single layer VN and TiN coatings**.** Our experiments demonstrate that the scalar and active levels of adhered platelets on coated samples are lower than those on stainless steel substrate. Here, denaturing and aggregation of the platelets are observed to be impeded, and platelet adhesion is also reduced on the coated surface.

Bacterial Attachment Studies

Fig. 32 shows the typical epi-fluorescence microscope images of the TiN/VN multilayer, TiN, VN single layer coatings and bare AISI 316L stainless steel substrates after bacterial adhesions test.

The results of the present study show that the implants coated with TiN/VN multilayer presented a minor quantity of the surface covered by bacteria. The attached bacteria were higher on uncoated substrates with higher roughness than on coated substrates. As bacteria accumulated on the uncoated 316L stainless steel, they exhibited typical phenotypic properties of biofilm formation. Rough surface is one of the requirements for improved cell attachment and integration. Visual observation showed that TiN and VN single layer coatings had lesser bacterial cells compared to the substrate. Of all the coatings, the attachment of bacteria on TiN/VN multilayer coatings was found to be very minimum and without colonization because the multilayer coating surface had very smooth surface. Also, the film composition would have been responsible for the large variation in bacterial adhesion as it would have mediated the bacterial adhesion through charge transfer interactions.

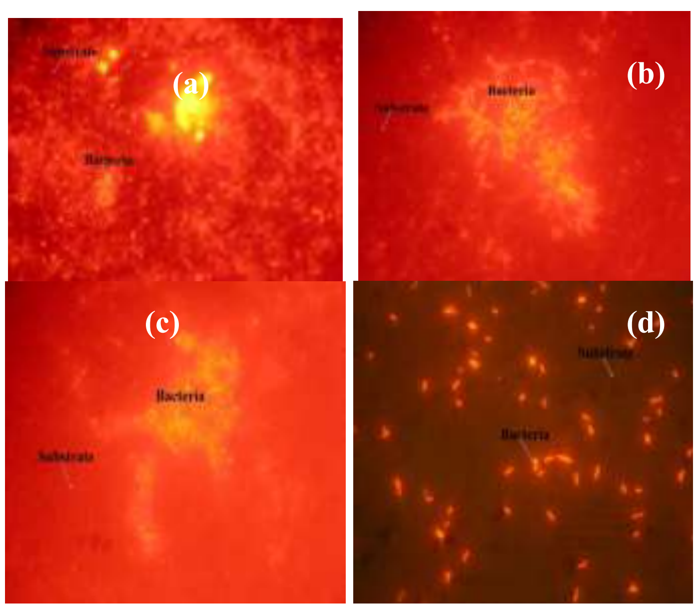


Fig.32. Bacterial adhesion image on (a) Steel Substrate (b) TiN film (c) VN film and (d) TiN/VN multilayered film.

Properties of Ti-Si-N

Structural and microstructural analysis

The XRD spectrum of TiN single layer coating is shown in **Fig.33.** They are crystallized in cubic structure with preferential orientation along (200) plane. The X-ray diffraction pattern of single phase Si_3N_4 coating showed no peaks, indicating its amorphous nature. The pattern shows only diffraction peaks due to crystalline TiN, with no indication of the presence of crystalline Si_3N_4 phases, suggesting that Si is present in amorphous state. The observed d values are in good agreement with the standard values with JCPDS card no 087-0633 for TiN coatings. XRD patterns revealed the presence of only one phase that can be assigned to the cubic B1 NaCl structure, typical for TiN and the peaks corresponding to (111), (200), (220), (311) and (400) planes were observed. The pattern shows only diffraction peaks with a TiN (2 0 0) preferred orientation. It is probably a solid solution (Ti, Si) N by a substitution of Si for Ti in TiN lattice, because the ionic radius of Si^{4+} ion (0.041nm) is smaller than that of Ti^{3+} (0.075 nm) ion. The average grain size value was calculated to be about 30-40 nm. The grain size reductions to the nanometer range result in considerable improvement in their resistance to localized corrosion.

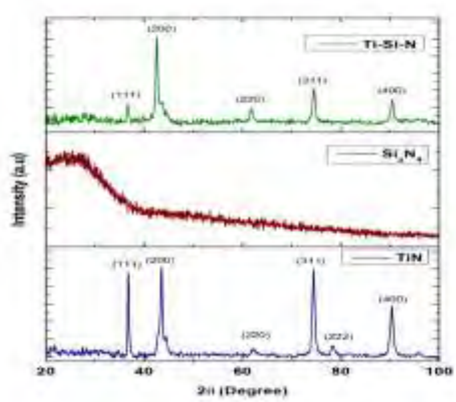


Fig.33. X-ray diffraction sprectra of nanocomposite coatings (a) TiN, (b) Si_3N_4 and (c) Ti-Si-N.

Nanohardness

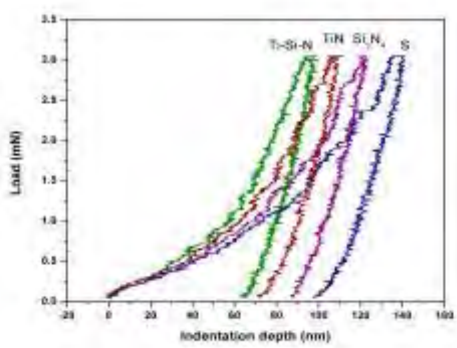


Fig.34. Typical load vs. displacement curves for 316LSS, Si_3N_4, TiN and Ti-Si-N nanocomposite coatings at 3 mN load.

Fig.34. compares the load–indentation depth curves for the steel substrate, single-layer TiN, Si_3N_4 as well as Ti-Si-N nanocomposite coatings. The indentation depth at a maximum load of 3mN decreases from 140 nm for the 316L SS substrate to 80 nm for Ti-Si-N nanocomposite coatings. The hardness of the 316L SS substrate was approximately 15 GPa. The indenter penetration depth of the Si_3N_4 single layer was approximately 110 nm at a hardness of approximately 21 GPa. When compared, the penetration depth in the TiN layer was approximately 93 nm and the hardness was 25 GPa whereas the Ti-Si-N nanocomposite coatings was approximately 81 nm and the hardness was 39 GPa. The hard coating layer formed on the steel surface increased the hardness. In particular, TiSiN film showed considerably enhanced hardness which could be attributed to the crystal size refinement due to the incorporation of Si in accordance with the Hall–Petch relationship. A strong tendency of decreasing the intensity and broadening the width of the TiN (111) peak was also observed indicating the diminution of the grain size or the residual stress induced in the crystal lattice. It could be confirmed that the Si incorporation reduced the crystal size and the residual stress and hence the higher hardness observed for these films.

Corrosion studies in simulated body fluid

Implant materials used inside a human body are generally exposed to a aqueous environment containing various anions (Cl^-, HCO_3^-, HPO_4^{2-}), cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), organic substances, and dissolved oxygen. Hence metallic implant materials are prone towards aqueous corrosion. Electrochemical impedance spectroscopy is a powerful technique to study the electrochemical properties of the PVD coatings system due to its high sensitivity to the coating structure. The Bode and Nyquist plots in **Fig.35 and Fig.36** respectively show the EIS spectra of coatings at open-circuit potential during the immersion in SBF solution. When the sample is immersed in the electrolyte the defects in the coating provide the direct diffusion path for the corrosive media. In this process the galvanic corrosion cells are formed and the localized corrosion dominates the corrosion process. The electrochemical interface can be divided into two sub-interfaces: electrolyte/coating and electrolyte/substrate. The single semicircle behavior obtained for the samples is believed to be due to the short exposure time (60 min), which is not sufficient to reveal the degradation of the substrat. The R_{ct} increases in the following order: Substrate <TiN < Si_3N_4 < Ti-Si-N.

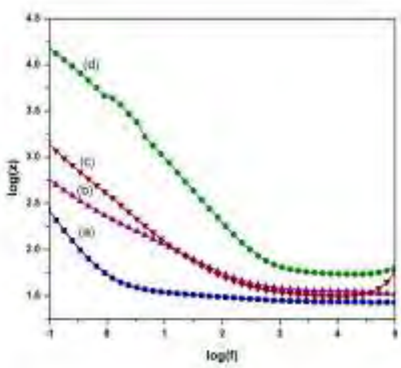


Fig.35. Bode plot for (a) 316L, (b) TiN, (c) Si_3N_4 and (d)Ti-Si-N coatings in SBF solution.

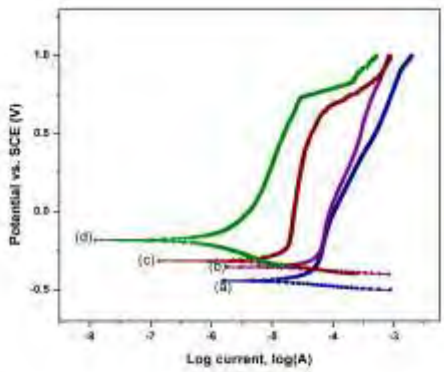


Fig.36. Potentiodynamic polarization curve for (a) 316L, (b) TiN, (c) Si_3N_4 and (d) Ti-Si-N coatings in SBF solution.

For the nanocomposite coatings, the TiSiN layers were deposited wherein the growth of the columnar structure of the individual TiN layer, which is detrimental to coatings used in severe corrosion environments, has been suppressed markedly. Therefore, the formation of through-coating pinhole channels is eliminated, which means that the possibility of the corrosive solution contacting the substrate is highly reduced. The comparative study of the impedance spectra of the specimens elicited that the TiSiN nanocomposite coatings had higher impedance values in the high frequency, indicative of a good protective effectiveness of the coating. In contrast, the total impedance of single layered TiN and Si_3N_4 coatings markedly changed with prolonged exposure to physiological solution due to degradation of the coating owing to pitting.

Typical potentiodynamic polarization curves of the coatings in deaerated SBF at 37 °C are shown in **Fig.36.** It can be seen the polarization curve for TiSiN nanocomposite samples had a significantly higher corrosion potential (−0.182 V) than that for samples (−0.355V for TiN and – 0.315V for Si_3N_4). The results confirmed that nanocomposite TiSiN coatings exhibited a better electrochemical behavior than TiN and Si_3N_4 coatings by virtue of more noble corrosion potential, although both curves were characterized by a very similar trend. The corrosion current density and polarization resistance (R_p) of the specimens were determined from the potentiodynamic polarization curves using Tafel extrapolation method. The polarization resistance is a parameter correlated to the corrosion rate. The higher the polarization resistance, the lower the corrosion rate was on the coating when exposed to SBF.

Preparation of amorphous $Zr_{48}Cu_{36}Al_8Ag_8$ thin films by ion beam sputtering and their corrosion behavior in SBF for bio implants

Thin film metallic glasses were prepared by plasma ion beam sputtering technique using HOUEI vacuum system on to AISI 316L stainless steel substrates. Fig.1 shows the schematic of ion beam sputtering unit. The layers were sputtered in pure Ar for a sputtering time of 5hrs.

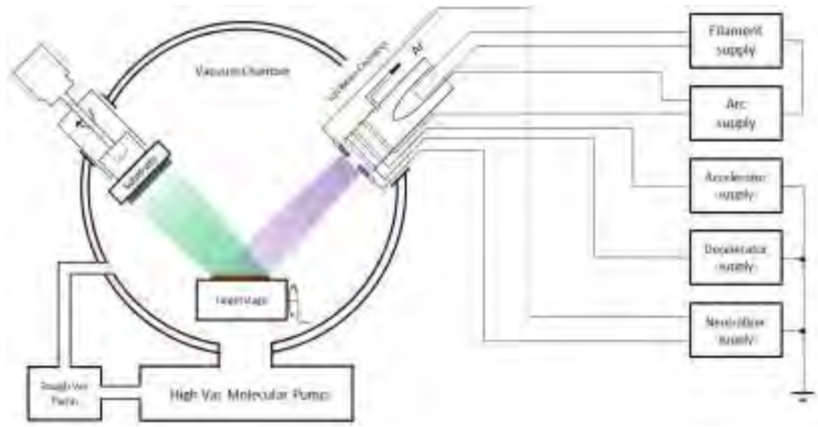


Fig.37. Schematic of Ion Beam Sputtering unit

X-ray diffractometry was employed to investigate the structural characteristics of the Zr- metallic glass thin film samples. The pattern as shown in **Fig.38a** demonstrates that the films are in an amorphous state featured by broad bumps at 2θ = 38° consistent with those of Zr-based bulk metallic glasses. The amorphous alloys consist of a single glassy phase, as evidenced by a main halo peak with no detectable peaks corresponding to crystalline phases. Micro XRD pattern shown in **Fig.38b** and the corresponding electron diffraction pattern (**Fig.38c**) also reveal a broad halo without a sharp peak for a crystalline peak indicating that they are fully amorphous.

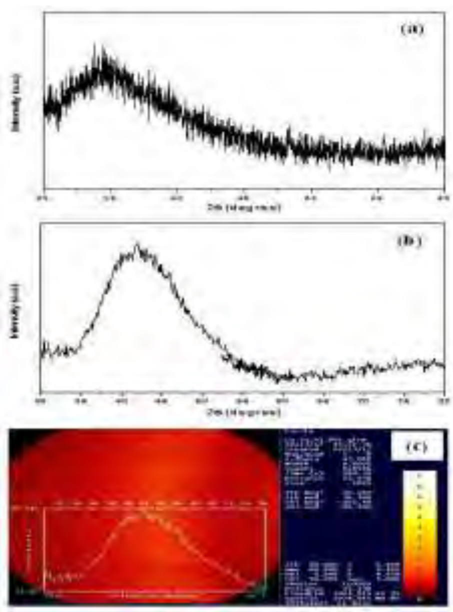


Fig.38. AFM surface of PSi (a) XRD pattern (b) Micro XRD pattern (c) Electron diffraction pattern of $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG

The SEM images of $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG onto 316L stainless steel surface is shown in **Fig.39**. It shows a smooth surface with few particles distributed in the amorphous matrix. No visible pores or micro cracks could be observed thereby showing good quality film deposition using ion beam sputtering.

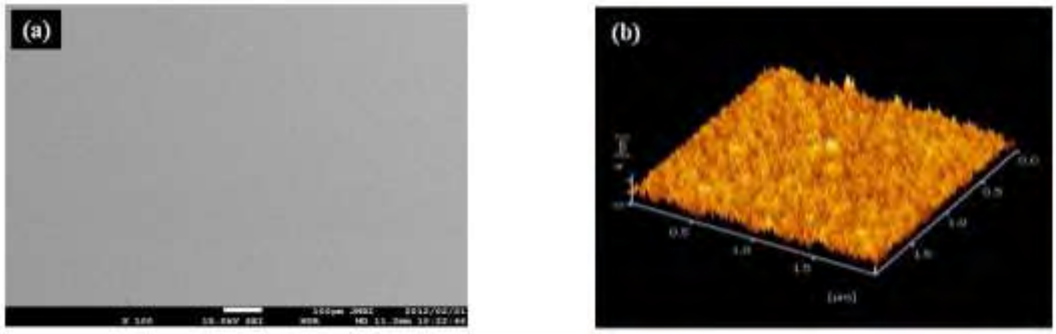


Fig.39. Surface morphology of $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG a) SEM b) 3D AFM image

The as-sputtered Zr – based TFMG presents a smooth and featureless surface as shown by AFM analysis in Fig.3b revealing that the film deposition can improve the surface finish of the 316 L stainless steel substrate. The root-mean-square (rms) surface roughness of the substrate decreases from 5.2 nm to 0.4 nm after the deposition of the glass-forming film. Therefore, the surface roughness of the coated substrates can be reduced, which will decrease the stress-concentration sites and increase the fatigue resistance of the coated materials.

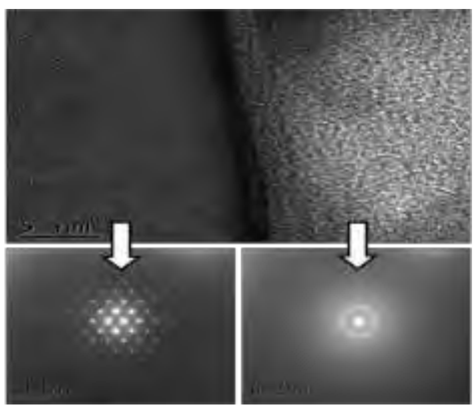


Fig.40. TEM image of $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG

The high resolution TEM image of an as-deposited film with maze-like patterns indicates the amorphous nature of the materials. Furthermore, the selected area electron diffraction (SAED) pattern (**Fig.40**) does not show any diffraction spots which confirms that the films are amorphous. As-deposited glass-forming thin films are dense and uniform, with nano-crystalline phases in the size range of 10–20 nm dispersed in the amorphous matrix.

Compositional analysis

In order to avoid the substrate effect on the measurement of the elastic modulus and nanohardness of the thin film, 160 nm deep indents are produced on the 1.5μm thick film as shown in **Fig.41.**

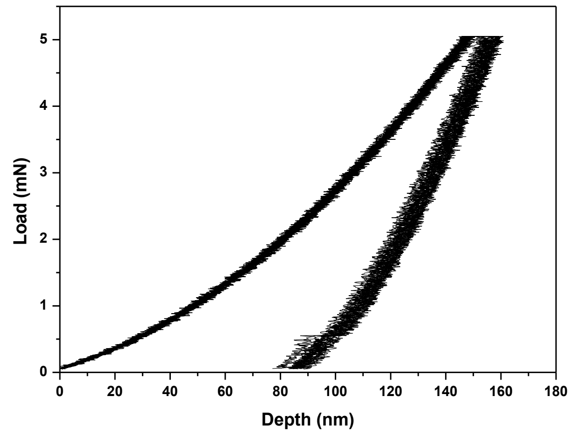


Fig.41. Load Vs Indentation curve obtained for $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG

The measured elastic modulus and hardness of the film are 117 GPa and 9.33 GPa, respectively whereas for the crystalline target, are around 87 GPa and 5.3 GPa, respectively. The measured values are higher than those of the bulk metallic glass which might be due to the difference in the microstructure between the as-sputtered film and the bulk counterpart and the hardness calculation method.

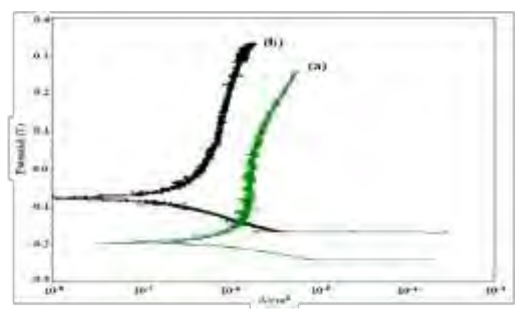


Fig.42. Tafel plots obtained for a) $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG on stainless steel substrate b) bare substrate in SBF

The corrosion behavior of the samples was examined with the help of potentiodynamic polarization measurements. **Fig.42(a) and (b)** show the polarization curves including anodic and cathodic polarization for the alloys in SBF solutions respectively at 300 K. It is observed that TFMGs were spontaneously passivated with completely similar polarization behaviors. The intersection of the cathodic and anodic branches in each curve occurred in the centre of the passive potentials. The corrosion potential (E_{corr}) and the corrosion current density (I_{corr}) are determined. Since the corrosion resistance is dominated by the corrosion current density, the lower the current density the higher is the corrosion resistance.

Fig.42(a) shows that the corrosion potential of Zr-based TFMG sputtered onto stainless steel substrate and the crystalline 316L stainless steel substrate are − 77.6mV −and 194.6mV respectively, in the SBF solution. Zr-based glassy alloy coated specimen possesses higher corrosion potential, indicating the excellent corrosion resistance from the view of corrosion thermodynamics. For the amorphous alloy, the passivation is observed at the beginning of anodic polarization. The passive film generated in the passivating process is destroyed slowly with the increase of potential. The passivation behavior with a significantly low current density indicates that highly protective and uniform surface films have been formed on the surface of the TFMGs exposed to the SBF solution. By contrast, there is no passivation in the procedure of anodic polarization for the crystalline base metal alloy, and corrosion rate is found to increase with the increase of potential. The structural and chemical homogenization is thought to be responsible for the better corrosion resistance of the amorphous alloys compared with the crystalline substrate in SBF solution. A porosity value of 0.067 was calculated using the relation for the $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG on stainless steel substrate indicating the good coverage of materials without imperfections in corroboration to SEM analysis.

Electrochemical impedance spectra

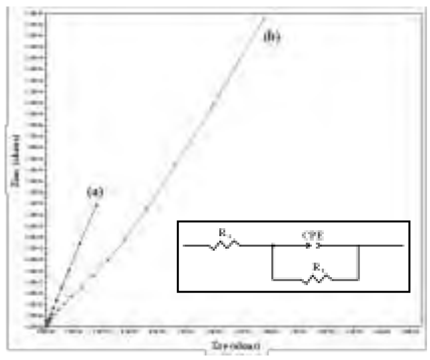


Fig.43. AC impedance studies on $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG on stainless steel substrate and equivalent circuit (insert)

Fig.43. shows the electrochemical impedance spectra (EIS) of samples in SBF solution. A lower polarization resistance value is observed for the crystalline 316L stainless steel substrate compared to the Zr- based amorphous film coated specimen. The Nyquist plots of the tested alloys present only one capacitive loop. The fitting model can be represented by the equivalent circuit composed of one parallel arrangement in series with the ohmic resistance and the result is shown **Fig.43** (insert), where the CPE is constant phase element instead of pure capacitance, taking account of the deviations of the system from the ideal state due to surface heterogeneities; *R*s is solution resistance; *R*ct is the electrochemical transfer resistance. In general, observation of semi-circle in the Nyquist plot is very much dependent on the resistance of the passive layer. According to our results, it is clearly seen that the amorphous alloy coated specimen has larger polarization resistance value than that of as sputtered glassy alloy specimen and the crystalline 316 L stainless steel substrate, which is in accordance with the lower passive current density. From the aforementioned analysis, the amorphous alloys present higher corrosion resistance compared with the crystalline substrate in the SBF solution. The result from electrochemical impedance spectra is consistent with that obtained by polarization curves.

Cytotoxicity

Cytotoxicity test for the $Zr_{48}Cu_{36}Al_8Ag_8$ TFMG specimen and bare 316L stainless steel substrate samples were assessed by MTT (3-[4, 5-dimethylthiazol-2-yl]-2, 5-diphenyltetrazolium bromide) assay. Briefly 2×10^4 cells/ml of HeLa cells were directly seeded in 24 well plates containing samples coated on metal plates. It was incubated for 24 hours at 37˚C in a humidified incubator supplied with 5% CO_2. After incubation, the growth medium was removed and the samples were washed once with Phosphate buffer saline (PBS, pH 7.4). The metabolic activity was assessed by incubating the samples with MTT solution (1mg/ml) at 37˚C for 3 hours. After incubation, hundred microlitre of DMSO was added to dissolve the formazan crystals (which gives purple colour if the cells are metabolically active). The absorbance was measured at 540 nm using multi well plate reader (Spectra Max M3). The percentage of viability was calculated by using the following formula

$$\%\text{ of Viability} = \frac{\text{Absorbance of Test}}{\text{Absorbance of the Control}} \text{ x } 100$$

An uncoated 316L stainless steel with 100 % viability was used as control. It was found that the percentage of viability was 99.2 for $Zr_{48}Cu_{36}Al_8Ag_8$ sample which indicates the non-cytotoxic nature of the sample.

Antimicrobial activity of sputtered nanocrystalline CuO immobilized fabrics

Structural analysis

The XRD spectra of sputtered copper oxide fabric of both woven and non-woven kinds along with uncoated fabric were shown in **Fig.44(a, b).** The peaks obtained on the uncoated fabric at 15.8°, 23°, 35° corresponds to woven type (**Fig.44c**) and peaks at 17.9°, 22.7° and 25° of non-woven type (**Fig.44d**) represent the presence of cellulose in those fabrics. The peaks at 35.6° and 38.7° both belongs to copper oxide (CuO) that was indexed to be (11-1) and (111) planes (JCPDS card 48-1548) respectively. The monoclinic crystal structure with average crystallite size of 15nm was obtained.

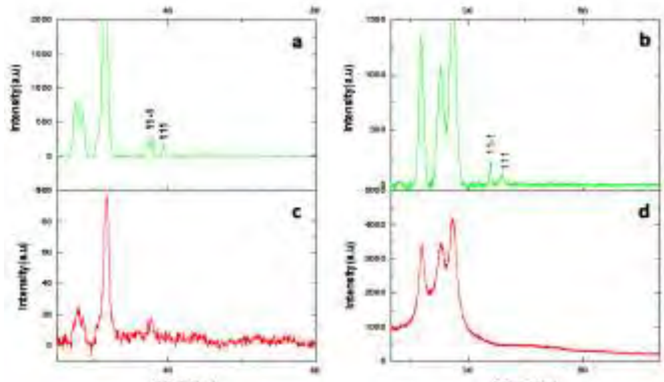


Fig.44. XRD pattern of sputtered copper oxide on (a) woven (b) non-woven fabrics; (c) uncoated woven fabrics (d) uncoated non woven fabrics.

Antimicrobial studies

The activity against both gram negative and gram positive bacteria revealed that copper oxide nanoparticles are dynamic antimicrobial agent by the measure of zones in agar plates. The presence of bacterial colonies on the agar plate inoculated with the test and control fabrics were shown in **Fig.45** for *E.coli* and *S.aureus*.

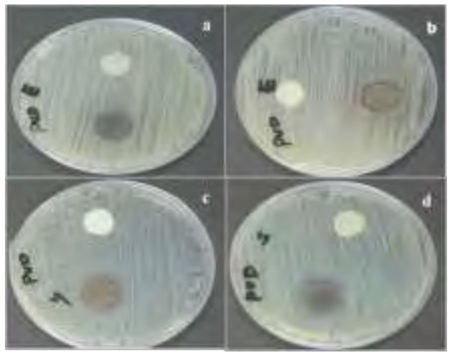


Fig.45 Zone of inhibition produced by copper oxide nanocrystals impregnated fabrics against *E.coli* bacteria (a) woven fabrics, (b) non woven fabrics and *S.aureus* bacteria (c) woven fabrics, (d) non woven fabrics

Clear transparent rings were obtained around the samples against the background of agar medium, showing the killing effect of bacterial cells. At the same time, the control fabric shows no symbol of inhibition against *E.coli* (**Fig.45a, b**) and *S.aureus* (**Fig.4c, d**). The zone of inhibition for both woven and non-woven fabrics give better results for *E.coli* and *S.aureus* are (15, 16mm) and (21, 20mm) respectively.

Bacterial attachment on fabrics

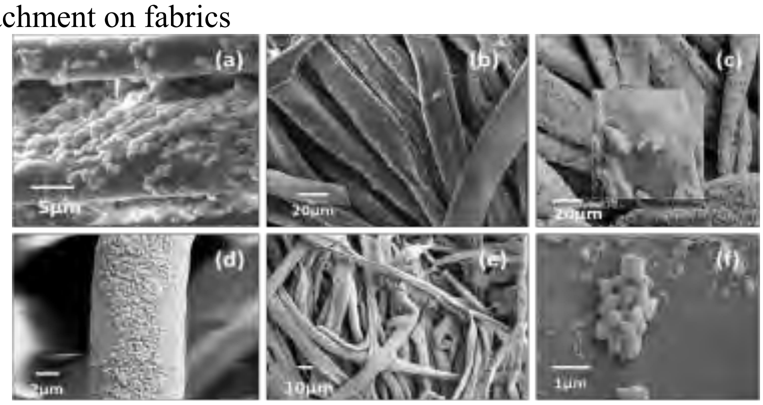


Fig.46 FESEM image taken on woven fabrics (a) control (uncoated) fabric with *E.coli* attachment (b) CuO Coated fabric (c) CuO coated fabric showing *E.coli* cell wall shrinkage and (d) control (uncoated) fabric with S.aureus attachment (e) CuO Coated fabric (f) CuO coated fabric showing S.aureus cell wall shrinkage.

The morphology of the *E.coli* and *S.aureus* bacterial attachment and copper oxide sputtered on woven and non-woven fabric was studied with the help of FESEM as shown in **Fig.46** and **Fig.47.** Cell wall damage of those bacteria was also noticed. The rod shaped structure of the *E.coli* bacteria on woven and non woven fabrics was confirmed as in **Fig.** (**46a** and **47a**). The size of the bacteria was about 2-3µm. The round shaped structure with an average size of about 2 µm of the *S.aureus* bacteria was also confirmed as in Fig.(46d and 47d). The cotton fiber showed twisted ribbon like structure with grooves, fibrils and the bacterial attachment was also found. The presence of bacterial colonies was dense in the control fabric. **Fig.(46b, 46e, 47b, 47e)** represents the CuO coated onto the woven and non woven fabrics revealing the uniform nature coating on the surface of the fiber.

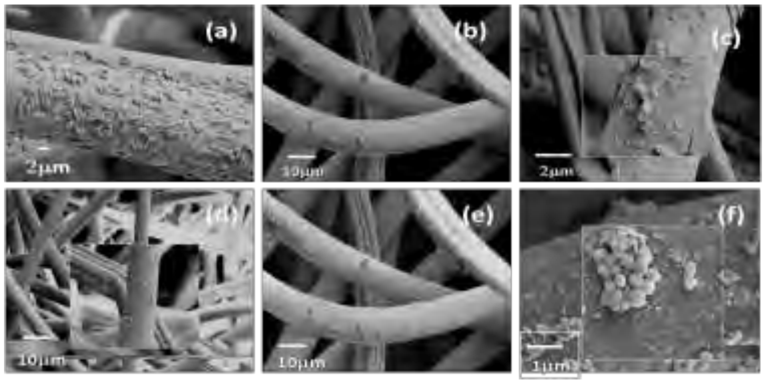


Fig.47 FESEM image taken on non woven fabrics (a) control (uncoated) fabric with *E.coli* attachment (b) CuO Coated fabric (c) CuO coated fabric showing E.coli cell wall shrinkage and (d) control (uncoated) fabric with S.aureus attachment (e) CuO Coated fabric (f) CuO coated fabric showing S.aureus cell wall shrinkage.

Copper oxide nanocrystals which act as antimicrobial agent damages *E.coli* bacteria by the effect of cell wall shrinkage and results in structural change from its regular rod shape to irregular structure as shown in **Fig. (46c and 46f).** The circular shaped *S.aureus* changes to irregular cubic structure as in **Fig (47c and 47f)** by the effect of antimicrobial agent Copper oxide nanocrystals. Shallow hole like depression also was seen on the bacterial cell.

The antimicrobial activity was further evaluated by measuring the killing efficiency of bacteria (*E.coli / S.aureus*) against various time intervals. The copper oxide sputtered test fabrics shows gradual increase in bacterial reduction efficiency with respect to time interval. The total viable count of bacterial colonies decreases progressively and reaches 100% within 10hours for *S.aureus* and 12 hours for *E.coli* bacteria. In all these cases, both copper oxide sputtered woven and non-woven fabric show better antimicrobial activity against both gram negative and gram positive bacteria.

The antimicrobial activity against both gram positive and gram negative bacterium showed good results for CuO sputtered fabric. The killing efficiency for *E.coli* and *S.aureus* strains suggest that the sputtered CuO impregnated fabrics can be used as promising antibacterial agents in medical applications.

Consultancy to Small Scale Inustry: Nano Markers, Trichy, Tamilnadu

“Advice on Sputter Coating of Titanium Nitride onto Nickel or Chrome Plated Stainless Steel Needles” to Nano Markers, Trichy –CNP 05/11

Date of Start : 02.12.2011 Date of Completion : 31.07.2012

Sputtering is the viable method over chemical methods like electroless deposition and is a eco-friendly process which can be a good substitute for chemical methods which cause severe environmental pollution problems. It is an advantageous method for preparing adherent, uniform, thick and mirror reflection coatings for multiple usage.

In this consultancy work, initially we did some feasibility studies on sputter coating of Titanium Nitride on needles and blades made of stainless steel and mild steel by optimizing the process parameters. After the satisfactory results, we have advised Nano Marker’s Trichy to purchase DC Magnetron sputtering facility with the complete required specifications. A DC magnetron sputtering equipment with a 4” dia cathode assembly was purchased from VR Technologies, Bangalore and installed it at Nano Marker’s Trichy. We performed few experiments in front of the client and trained them. Thereafter, we have made few visits to their company and discussed with them on the results of the experiments. They are advised to use the equipment for doing other coatings such as Silver, Sn, Chromium, Copper and Brass. It is understood from the discussion that they are able to fabricate successfully these coatings now. The work has been completed to the satisfaction of the client. The photographs of the facility created at their end with the products are shown under.

Photograph of Sputtering facility at Nano Markers, Photograph of Sputtering –Ar plasma, Ar +N_2 plasma

TiN coated needles

TiN coated blades

NANO MARKER'S

LASER CUTTING ENGRAVING MARKING

22,SUDARSAN NAGAR,
SRIRANGAM
TRICHY - 620 006
INDIA

WWW.NANOMARKERS.CO.IN
EMAIL:PRABALU@YAHOO.CO.IN
9150053500

Dt:- 8/11/2012

To

The Director,
Central Electrochemical Research Institute,
KARAIKUDI - 630006

Respected Sir,

We approached CECRI for Sputter coating of TITANIUM NITRIDE ON TO NICKEL or CHROMPLATE STAINLESS STEEL NEEDLE during November, 2011.

In this connection, we had a consultancy service from your scientists. As per advice of scientist team from ECMS division of CECRI, we carried out the process successfully. We purchased SPUTTER COATING MACHINE WITH ALL ESSENTIAL ACCESSORIES as guided by ECMS SCIENTIST TEAM.

We are satisfied with their results obtained from our machine.

We are very much thanks full to Scientist team

The Director of CECRI,
Dr. Balasubramanian --- ECMS DIVISION &
Dr. Jayachandran ------ HOD OF ECMS DIVISION, JOINT DIRECTOR

for their help in solving our problem successfully.

We seek your continuous support to us in FUTURE also.

Thanking you.

Yours faithfully,

For NANO MARKER'S
S. P...
Proprietor
8/11/2012

ANNEXURE – II

Total Papers Published: 220 (International SCI Journals/Natioinal Journals/Cited in SCOPUS)-188/23/9

Papers published in International SCI Journals/Natioinal Journals on various subject areas like: Electrochemical Science & Technology, Physical Sciences, Chemical Science, and Nano Science & Technology.

List of Research Publications

Sl. No.	Title of the Paper	Authors	Journal Name	IF	Citation
220.	Antibacterial Activity Studies of Ni and SnO_2 loaded chitosan Beads	A.Ayesmariam G.V.Sankaracharyulu,M.Kashif, S.Hussian,M.Bououdina, and M.Jayachandran	Materials Science Forum 832(2015) 110-122		
219.	Enhanced Violet Photomission of nano crystline fluorine doped Zinc oxide (FZO) thin filims	Anusha Muthukumar, D.Arivuoli, E.M.Manikandan, M.Jayachandran	Optical Materials 47(2015)88-94		
218	Synthesis, Structural and Electrical Characterizations of SnO2 Nanoparticles	N.Manjula, G.Selvan, R.Perumalsamy, R. Thirumamagal, A.Ayeshamariam, M.Jayachandran	International Journal of Nanoelectronsics and Materials 8(2015),Accepted		
217	Well aligned Graphene oxide Nanosheets decorated with Zinc Oxide Nanocrystals for high Performance Photocatalytic Aapplication	K.Kaviyarasu,C.Maria Magdalane,E.Manikandan, M.Jayachandran, R.Ladchumananandasivam, S.Neellamani,M.Maaza	International Journal of Nanoscience 14, (2015)1550007(8 pages).	1.82	
216	Studies on growth mechanism of annealed graphite powder and gas-sensor application	P.Pounsuria,Sahid hussian,B.H.Abbas Sahul Hameed,R.Permalsamy,R.Thirumamagal,M.Jayachindran and A.Ayeshamarimam	Materialls Science Forum 832(2015)102-105		

215	Structural,morphological and optical characterization of electroposited ZnSe thin filims	A.Ayeshmariam,M.kashif,D.saravanakumar,S.muthuraj M.Jayachandran M.Bououdina	J.Indian Chem Soc.,92(2015) 747754		
214	Review on the materials properties and photoelectrochemical(Pec) solar cells of CdSe,Cd_{1-X} Zn_X Se,Cd_{1-x} In_x Se, thin films	S.Rani,J.Shanthi,S.Thangarajan Ayeshamariam, and M.Jayachandran	Material Science Forum 832 (2015) 1-27		
213	Biosynthesis of ZnO In2O3-A.vera)Nanocomposites and Antibacterial-al/Antifungal Studies	**Error! Not a valid link.**,	International Journal of Nanoelectronsics and Materials 8(2015),Accepted		
212	Properties of SnO2-Tio2 composite films deposited using jet nebulizer Spary Pyrolysis for gas sensor	N.Manjula, G.Selvan,S.Thangarajan,,Ayeshamariam,S.Muthuraja and M.Jayachandran	Material Science Forum 832(2015) 94-101		
211	Studies on jet nebulizer pyrolysed indium oxide thin films and its characterizations	S. Marikkannu, M. Kashif, A. Ayeshamariam, V. S. Vidhya, N. Sethupathi, Shakkthivel Piraman, M. Jayachandran	International Journal of Nanoelectronics and Materials 8(2015)99-110		
210	Studies on the influence of in and Zn doping on the CdSe based photo electro chemical(PEC) solar cells using electron beam evaporation technique	S.Rani,J.Shanthi, S.Thangarajan, Ayeshamariam, and M.Jayachandran	Material Science Forum 832(2015) 84-93	1.82	
209	Multilayer and Nanocomposite Hard Coatings for Biomedical Applications	M. Jayachandran	Powder Metallurgy & Mining J. Powder Metall Min 2014, 3:1		
208.	Bio-Synthesis of NiO and Ni Nanoparticles and their characterization	A.Ayeshamariam, M. Kashif, S. Muthu raja, S. Jagadeswari, D. Saravanankumar, N.M.I. Alhaji, A. Uduman Mohideen, M.Bououdina, M. Jayachandran.	Digest Journal of Nanomaterials and Biostructures 9 (2014) 1007-1019		
207.	Antimicrobial activity of sputtered nanocrystalline CuO impregnated fabrics.	B. Subramanian*, K. Anu Priya, S. Thanka Rajan, .Dhandapani, M. Jayachandran.	Materials Letters 128(2014) 1-4	2.367	1
206.	3D Hierarchically assembled porous wrinkled paper-like structure of ZnCo2O4 and Co-ZnO@C as anode materials for lithium-ion batteries.	Giri Arnab, Pal Provas, A. Ramadoss, M. Jayachandran, Mahanty sourindra, A. Panda.	Crystal Growth and Design 14 (2014)3352-3359	4.558	3
205.	Studies of calcium-precipitating oral bacterial adhesion on TiN, TiO2 single layer, and TiN/TiO2 multilayer-coated 316L SS.	G. S.Kaliaraj, A.Ramadass, M.Sundaram, B.subramanian, M.Jayachandran.	J. Master. Sci 49 (2014) 7172-7180	2.26	
204.	Biosynthesis of ZnO-A.vera) Nanocomposites and Antibacteri-al/Antifungal Studies	**Error! Not a valid link.**	Journal of Optoelectronics and Biomedical Materials 6(2014)85-99		2

203.	Effect of Substrate temperature on Indium Tin Oxide (ITO) thin films deposited by jet Nebulizer Spray.	S.K Marikkannu, Kashiff, Sethupathi, V.S Vidya, A.P. Sakthivel, M. Bououdina, M. Jayachandran.	Materials Science in Semiconductor Processing 27 (2014) 562-568		3
202.	Studies on jet nebulizer pyrolysed indium oxide thin flims	S.Marikannu, M.Kasif, A.Ayeshamariam, N.Sethupathi, V.S. Vidhya, S.Piraman, M.Jayachandran.	Journal of Ovonic Research 10 (2014) 115-125		
201.	Optical Characterisation of ZnSe Thin Flims by Using Electro Deposition Technique.	A.Ayeshamariam, M. Kashif, S. Muthu raja, S. Jagadeswari, D. Saravanankumar, N.M.I. Alhaji, A. Uduman Mohideen, M.Bououdina, M. Jayachandran.	IJETAE 4, (2014) 584-590		
200.	Quantum confinement and photoluminescence of well-aligned CdO nanofibers by solvothermal route	K. Kaviyarasu, E. Manikandan, J. Kennedy, M. Jayachandran	Materials Letters 120(2014)243-245	2.28	
199.	Fabrication of nanowires of Al-doped ZnO using nanoparticle assisted pulsed laser deposition (NAPLD) for device applications	Thanka Rajan S., Subramanian B., Nandakumar A.K., Jayachandran M., Ramachandra Rao M.S.	J. Alloys and Compounds, 584(2014) 611-616.	2.13	8
198.	Preparation and characterizations of SnO_2 nanopowder and spectroscopic (FT-IR, FT-Raman, UV-Visible and NMR) analysis using HF and DFT calculations,	A.Ayeshamariam A. Ramalingam S. Bououdina M. Jayachandran	Spectrochemica Acta Part A: Molecular and Biomolecular Spectroscopy, 118(2014)1135-1143.	2.16	6
197.	Morphological, structural, and gas-sensing characterization of tin-doped indium oxide nanoparticles	A. Ayeshamariam, M. Kashif, M. Bououdina, U. Hashim, M. Jayachandran, M.E. Ali	Ceramics International 40 (2014) 1321–1328	2.110	
196.	Organic Free Low Temperature direct Synthesis of Hierarchical Protonated layered Titanates /anatase TiO_2 hollow spheres and their task specific applications	Narottam Sutradhar, Sandip Kumar Pahari, Muthirulandi Jayachandran, A Manuel stephan, J.R.Nair, Balasubramanian Subramanian, Hari.C.Bajaj, Haresh M. Mody, Asit Baran Panda	Journal of Materials Chemistry A1 (2013) 9122-9131.	6.101	
195.	Shape-selective synthesis of non-micellar cobalt oxide (CoO) nanomaterials by microwave irradiations	Subrata Kundu, M. Jayachandran	J. Nanopart Res 15(4) (2013) 1-13	3.287	11
194.	Facile fabrication of dye-sensitized solar cells utilizing carbon nano tubes grown over 2D hexagonal bimetallic ordered mesoporous materials	J. Balamurugan, R. Thangamuthu, A. Pandurangan, M. Jayachandran	J.Power Sources 225 (2013) 364-373	4.951	2
193.	Formation of shape-selective magnetic cobalt oxide nanowires: environmental application in catalysis studies	Subrata Kundu, M. D. Mukadam, S. M. Yusuf, M. Jayachandran	Crystal Engineering Communicatons 15 (2013) 482-497	3.842	10
192.	CeO_2 nanowires with high aspect ratio and excellent catalytic activity	Provas Pal, Sandip Kumar Pahari, Apurba Sinhamahapatra, Muthirulandi	RSC Advances 3(2013) 10837-10847.	2.56	5

	for selective oxidation of styrene by molecular oxygen	Jayachandran, G.V. Manohar Kiruthika, Hari C. Bajaj, Asit Baran Panda			
191.	Fabrication of amorphous $Zr_{48}Cu_{36}Al_8Ag_8$ thin films by ion beam sputtering and their corrosion behavior in SBF for bio implants	B. Subramanian, S. Yugeswaran, Akira Kobayashi, M. Jayachandran	Journal of Alloys and Compounds 572(2013)163-169	2.13	5
190.	Self-assembling of DNA-Templated Au Nanoparticles into Nanowires and their enhanced SERS and Catalytic Applications	S.Kundu, M.Jayachandran	RSC Advancs 3 (2013) 16486-16498	2.56	14
189.	Suitability evaluation of plasma ion beam sputtered TiN/TiOxNy multilayers on steel for bio implants	B. Subramanian, R. Ananthakumar, S. Yugeswaran, M. Jayachandran, M. Takahashi, Akira Kobayashi	Vacuum 88 (2013) 108-113	1.426	5
188.	Nanoparticles of In2O3/SnO2 (90/10) and (80/20) at Two Different Proportions and Its Properties	Abbas Ayeshamariam, Vinodh Sundar Vidhya, Thangavel Sivakumar, Ramasamy Mahendran, Ramasamy Perumalsamy, Nallasamy Sethupathy, Muthurulandi Jayachandran	Open Journal of Metal, 3(2013)1-7		
187.	Green Synthesis of Nanostructured Materials for Antibacterial and Antifungal activities	A. Ayeshamaraim Tajun Meera Begum, M.Jayachandran G.Praveen Kumar M. Bououdina	Int. J. Bioassays 02 (01) (2013) 304-311	-	2
186.	Compositional & surface morphological analysis on indium tin oxide thin films prepared by radio frequency sputtering	V. Malathy, M. Jayachandran	Asian Journal of Chemistry Vol.25, Issue SUPPL, (2013) S279-S282		
185.	Synthesis and Characterizations of SnO_2 Nanoparticles	A. Ayeshamariam, V.S. Vidhya, S. Sivaranjani, M. Bououdina, R. PerumalSamy, M. Jayachandran	Journal of Nanoelectronics and Optoelectronic 8, (2013)273-280		
184.	Anodic corrosion behavior of nanostructured TiN, TiO2 single layer and TiN/TiO2 multilayer coated 316L SS	S.H.Gopi,R.Aananthakumar,B.Subramanian, S Maruthamuthu, M. Jayachandran	IEEE Eplore,Advanced Nanomaterials and Emerging Engineering Technologies (ICANMEET), (2013)331-334		
183.	Electrochemical Noise analysis on Sputtered Chromium Nitride Coated D9 Steels	B.Subramanian, K.Prabakaran, V.V.Anusha Thampi and M.Jayachandran	Int. J. Electrochem. Sci., 8 (2013)12015-12027		
182.	Size-controllable synthesis of ITO nanoparticles and application in gas sensor	A. Ayeshamariam, R.Perumalsamy, M. Jayachandran	Journal on Photonics and Spintronics 08/2013; 2(3):4.		
181.	Fabrication of Catalytically active nanocrystalline samarium (Sm)-doped cerium oxide (CeO_2) thin films using electron	Subrata Kundu, Narottam Sutradhar, R. Thangamuthu, B. Subramanian, Asit Baran Panda, M. Jayachandran	J. Nanopart Res 14 (2012) 1040	3.287	6

	beam evaporation				
180.	Microstructural, Tribological and Electrochem. Corrosion Studies on Reactive DC Magnetron Sputtered Zirconium Nitride films with Zr Interlayer on Steel	B. Subramanian, V. Swaminathan M. Jayachandran	Metals & Materials International 18 (2012)957-964	1.183	1
179.	Influence of nitrogen flow rates on the materials properties of CrNx films grown by reactive magnetron sputtering	B. Subramanian K. Prabakaran M. Jayachandran	Bulletin of Materials Science35 (2012)505-511	0.88	5
178.	Effect of substrate temperature on structural, morphological and optical properties of crystalline titanium dioxide films prepared by DC reactive magnetron sputtering	R. Ananthakumar B. Subramanian S. Yugeswaran M. Jayachandran	Journal of Materials Science: Materials in Electronics 23 (2012) 1898-1904	1.076	4
177.	Deposition and optoelectronic properties of ITO (In_2O_3:Sn) thin films by Jet Nebulizer Spray (JNS) pyrolysis Technique	N. Sethupathi, P. Thirunavukkarasu, V.S. Vidhya, R. Thangamuthu, G.V.M. Kiruthika, K. Perumal, Hari C. Bajaj and M.Jayachandran	J.Materials Science:Material in Electronics 23 (2012) 1087 - 1093	1.076	5
176.	Bio synthesis of calcium hydroxyl apatite coating on sputtered Ti/TiN nano multilayers and their corrosion behavior in simulated bodily solution	B.Subramanian, P.Dhandapani, S.Maruthamuthu and M.Jayachandran	Journal of Biomaterials Applications 26 (2012) 687-705	2.246	
175.	Surface modification of 316L stainless steel with magnetron sputtered TiN/VN nanoscale multi layers for bio implant applications	B.Subramanian, R.Ananthakumar, Akira Kobayashi and M. Jayachandran	Journal of Materials Science: Materials in Medicine 23 (2012) 329-338	1.076	11
174.	Nanocomposite Ti-Si-N coatings deposited by reactive dc Magnetron sputtering for biomedical applications	B.Subramanian R.Ananthakumar, Akira Kobayashi and M.Jayachandran	J. American. Ceramic. Society 205 (2012) 5014-5020	2.272	
173.	Electrochemical corrosion & materials properties of reactively sputtered TiN/TiAlN multilayer coatings	B. Subramanian, R.Anandakumar, Akira Kobayashi M.Jayachandran	Ceramics International 38 (2012) 477-485	1.751	16
172.	Morphology and optical measurements of nanostructured In_2O_3: SnO_2 nanoparticles	Ayeshamariam C.Sanjeeviraja,M.Jayachandran M. Tajun Meera Begam	World J. NanoSci. Eng. 2 (2012) 6-12		1
171.	A comparative study of titanium nitride (TiN), titanium oxy nitride (TiON) and titanium aluminium nitride (TiAlN), as surface coatings for bio implants	B. Subramanian, C.V. Muralidharan, R.Ananda kumar, M.Jayachandran	Surface & Coatings Technology 205 (2011) 5014-5020	2.135	46
170.	Effect of substrate temperature on the properties of reactively sputtered TiN/NbN	B. Subramanian, R.Ananthakumar, M.Jayachandran	Crystal.Res.Tech 46 (2011) 1273-1282	0.95	1

	multilayers				
169.	Preparation of chromium oxynitride and chromium nitride films by DC reactive magnetron sputtering and their material properties	B. Subramanian, M.Jayachandran	Corros.Eng.Sci. Technol 46 (2011) 554 – 561	0.50	
168.	Allylic and benzylic oxidation over Cr (III) – incorporated mesoporous zirconium phosphate with 100% selectivity	A.Sinhamahapatra, N.Sutradhar, SK.Pahari, P.Pal, HC.Bajaj, M.Jayachandran A.B.Panda	Chem. Cat. Chem. 3 (2011) 1447-1450	3.35	2
167.	Study on (Mo/W) Se_2 layered compound semiconductors useful for photoelectrochemical solar cells	S.Mary Delphine, M.Jayachandran C.Sanjeeviraja, AW.Almusallam	Int.J.Chem. Tech. Res. 3 (2011) 846-852	-	4
166.	Facile Low-Temperature Synthesis of Ceria and Samarium-Doped Ceria Nanoparticles & Catalytic Allylic Oxidation of Cyclohexene	.Sutradhar, A.Sinhamahapatra, , SK.Pahari, M.Jayachandran B.Subramanian, HC.Bajaj, A.B.Panda	Journal of Physical Chemistry C 115 (2011) 7628–7637	4.52	26
165.	Structural and electrochemical impedance spectro-scopic studies on reactive magnetron sputtered Ti oxynitride (TiON) thin films	P. Padmavathy, R. Ananthakumar,B. Subramanian, C. Ravidhas, M.Jayachandran	Journal of Applied Electrochemistry 41(2011) 751-756	1.49	4
164.	Effect of nitrogen ion implantation on structural and microstructural properties of reactive magnetron sputtered TiN thin films	B. Subramanian, R.Ananthakumar,N.Kobayashi, M.Jayachandran	Transactions of the Institute of Metal Finishing 89 (2011) 28-32	1.62	1
163.	Influence of RF power on the growth mechanism, preferential orientation and optoelectronic properties of nano crystalline ITO films	V.S. Vidhya, V. Malathy, T. Balasubramanian, V. Saminathan, C.Sanjeeviraja, M.Jayachandran	Current Applied Physics 11 (2011) 286-294	1.74	8
162.	Structural and tribological properties of DC reactive magnetron sputtered titanium /titanium nitride (Ti/TiN) multilayered coatings	B. Subramanian, R.Ananthakumar, M.Jayachandran	Surface & Coatings Technology 205 (2011) 3485–3492	2.135	20
161.	Development of porous silicon matrix and characteristics of porous silicon/ tin oxide structures	V.S.Vidya, P.Padmavathy, K.R.Murali, C.Sanjeeviraja, P.Manisankar, M.Jayachandran	J.Non Crystalline Solids 357(2011) 1522 - 1526	1.483	
160.	Photoluminescence studies on porous silicon/ tin oxide heterostructures	V.S.Vidya, K.R.Murali, B.SubramanianP.Manisamkar, C.Sanjeeviraja, M.Jayachandran	J. Alloys and Compounds 509(2011) 2842-2845	2.13	1
159.	Structural, optical, electrical and luminescent properties of electron beam evaporated CdSe:In films	M.G.S.A.Basheer,K.S.Rajni, V.S.Vidya, K.R.Murali, M.Jayachandran	Crystal Research and Technology 46(2011) 261- 266	0.95	12

158.	Electrodeposition and properties of nanocrystalline ZnO films prepared in the presence of anionic surfactantSDS and ionic liquid 1- butyl-3 methylimidazolium methyl sulfate	V.S.Vidya, J.V.Rani, A.R.Kumar R.Thangamuth, K.R.Murali, M.Jayachandran	J.Materials Science:Materials in Electronics 22 (2011) 1460 - 65	0.93	3
157.	Photoluminescence studies on $ZnSe_{1-x}Te_x$ films	K.Vijayakumar, V.S.Vidya, L.Amalraj, K.R.Murali, M.Jayachandran	J.Materials Science:Materials in Electronics 22 (2011) 785 - 789	0.93	
156.	Structural, optical and electrical properties of $ZnTe_{1-x}Se_x$ thin films	V.S.Nagarathinam, M.G.S.B.Ahamed K.Vijayakumar, L.Amalraj, A.R.Balu, A.Thayumanavan K.R.Murali, M.Jayachandran	J.Materials Science:Materials in Electronics 22 (2011) 607 - 613	0.93	2
155.	Characterization of Tin disulphide thin films prepared at different substrate temperature using spray pyrolysis technique	K. Vijayakumar, C. Sanjeeviraja, M.JayachandranL.Amalraj	J. Mater Sci: Mater Electronics 22 (2011) 929-935	0.93	3
154.	Synthesization, characterization and gas sensing properties of SnO_2 nanoparticles	A.Ayeshamariam, C.Sanjeeviraja M.Jayachandran	Int. J Chemical and Analytical Science 2 (2011) 54-61	-	1
153.	Influence of substrate temperature on the materials properties of reactive DC magnetron sputtered Ti/TiN multilayered thin films	B.Subramanian, R.Ananthakumar, VS.Vidhya, M. Jayachandran	Mat. Sci. and Eng. B: Solid State Materials for Advanced Technology 176 (2011) 1-7	1.715	19
152.	Micro-structural and optical properties of reactive magnetron sputtered Aluminum Nitride (AlN) nano structured thin films	B. Subramanian, V. Swaminathan, M. Jayachandran	Current Applied Physics 11 (2011) 43-49	1.90	7
151.	Review of material properties of $(Mo/W)Se_2$-layered compound semiconductors useful for photoelectrochemical solar cells	S.M.Delphine,M.Jayachandran C.Sanjeeviraja	Crystallography Reviews 17 (2011) 281-301	4.091	7
150.	Synthesis and characterization of LiMVO4 cathode material produced by sol-gel method	D. Prakash, M.Jayachandran C.Sanjeeviraja	American Institute of Physics Conference Proceedings(PART A) 1349 (2011) 233-234	1.029	
149.	Nanomaterials preparations by microwave-assisted solution combustion method and material properties of SnO_2 powder – A status review	L.C. Nehru,V. Swaminathan M.Jayachandran C.Sanjeeviraja	Materials Science Forum 671 (2011) 69-120	0.399	1
148.	Review on gallium zinc oxide films: Materials Properties and preparation techniques	S. Nagarani, M.Jayachandran C.Sanjeeviraja	Materials Science Forum 671(2011) 47-68	0.399	3
147.	Influence of thickness on	M.G.S.A.Basheer,	Materials Science		

	the microstructural, optoelectronic and morphological properties of nano crystalline ZnSe films.	V.S.Nagarathinam, A.Thayumanvan,K,R.Murali, C.Sanjeeviraja, M.Jayachandran	and Engineering B 171 (2010) 93-98	1.715	8
146.	Effect of thickness on the microstructural, Optoelectronic, morphological properties of electron beam evaporated ZnTe films	A.R.Balu,V.S.Nagarathinam,M. G.S.A.Basheer A.Thayumanavan K.R.Murali, C.Sanjeeviraja, M.Jayachandran	Journal of Alloys and Compounds 502 (2010) 434–438	2.135	10
145.	Influence of substrate temperature on the properties of electron beam evaporated ZnSe films	A.R.Balu, V.S.Nagarathinam A.Thayumanavan K.R.Murali,C.Sanjeeviraja, M.Jayachandran	Cryst. Res. Technol 45 (2010) 421 - 426	0.95	5
144.	Structural, optical and electrical properties of electron beam evaporated CdSe thin films	M.G.S.A.Basheer V.S.Nagarathinam, A.R.Balu, K,R.Murali, A.Thayumanvan,C.Sanjeeviraja, M.Jayachandran	Cryst. Res. Technol. 45 (2010) 387 - 392	0.95	8
143.	Structural, optical, electrical and morphological properties of ZnTe films deposited by electron beam evaporation	M.G.S.A.Basheer V.S.Nagarathinam, A.R.Balu,A.Thayumanvan, K,R.Murali,C.Sanjeeviraja, M.Jayachandran	J.Materials Science:Materials in Electronics 21 (2010)1229 - 1234	0.93	4
142.	Thermal and optical properties of Cd_2SnO_4 thin films using photoacoustic spectroscopy	K. Jeyadheepan, Palanichamy, V.Swaminathan,C.Sanjeeviraja	Appl Phys A: Mat. Sci. and Processing 98 (2010) 919	1.595	15
141.	XRD and XPS characterization of mixed valence Mn_3O_4 hausmannite thin films prepared by chemical spray pyrolysis technique	A. Moses Ezhil Raj, S. Grace Victoria, V. Bena Jothy, C. Ravidhas, Joachim Wollschlaer, M. Suendorf, M. Neumann, M.Jayachandran, C.Sanjeeviraja	Applied Surface Science 256 (2010) 2920–2926	1.616	59
140.	Thickness Dependence of Structural, Electrical & Optical Properties of Sputter Deposited Indium Tin Oxide Films	S. Sivaranjani, V. Malathy, Prince, B. Subramanian, T. Balasubramanian, C. anjeeviraja,M,Jayachandran, V.Swaminathan	Advanced Science Letters 3 (2010) 434–441	1.253	2
139.	Structural and electrical studies of nano structured $Sn_{1-x}Sb_xO_2$ (x = 0.0, 1, 2.5, 4.5 and 7 at%) prepared by co-precipitation method	V. Senthilkumar, P. Vickraman, C. Sanjeeviraja, ,Jayachandran	J. Mater Sci: Mater Electron 21 (2010) 343–348	0.93	17
138.	Defect engineering and opto electronic property modifications by 1.5 MeV Li^+ implantation on nano crystalline $MgIn_2O_4$ thin films	A. Moses Ezhil Raj, T. Som, C. Sanjeeviraja, M.Jayachandran	Radiation Effects & Defects in Solids: Incorporating Plasma Sci. & Plasma Tech. 165 (2010) 265–276	0.55	2
137.	Structural and optical properties of indium tin oxide (ITO) thin	V. Senthilkumar, P. Vickraman, M.Jayachandran, C. Sanjeeviraja,	Vacuum 84 (2010) 864–869	0.975	

	films with different compositions prepared by electron beam evaporation				35
136.	Spray deposition and property analysis of anatase phase titania (TiO_2) nanostructures	A. Moses Ezhil Raj, V.Agnes, V. Bena Jothy, C. Ravidhas, Joachim Wollschlaer, M. Suendorf, M. Neumann, M.Jayachandran, C.Sanjeeviraja	Thin Solid Films 519 (2010) 129–135	1.727	11
135.	Growth of ZnSe thin layers on different substrates and their structural connsequences with bath temperature	A. Moses Ezhil Raj, S. Mary Delphine, C. Sanjeeviraja, M.Jayachandran	Physica B: Condensed Matter 405 (2010) 2485-2491	1.056	18
134.	Role of substrate temperature on the structural, optoelectronic and morphological properties of (400) oriented indium tin oxide thin films deposited using RF sputtering technique	V. Malathy, S. Sivaranjani, V. S. Vidhya, T. Balasubramanian, Joseph Prince, C. Sanjeeviraja, M.Jayachandran	J Mater Sci: Mater Electron. 21 (2010) 1299–1307	0.93	5
133.	Microstructura, mechanical and electrochemical corrosion properties of sputtered Titanium –Al- Nitride films for bio implants	B. Subramanian, R.Ananthakumar, M.Jayachandran	Vacuum 85 (2010) 601-609	1.431	13
132.	Synthesis and characterization of SnO_2 nanopowder prepared by precipitation method	V.Senthil kumar, P.Vickraman, M.Jayachandran, C.Sanjeeviraja	Journal of Dispersion Science and Technology 31 (2010) 1178-1181	0.628	3
131.	Effects of deposition temperature on materials properties of magnetron sputtered titanium nitride coatings on mild steel substrates with Ni interlayer	B. Subramanian , K.Ashok,G.Selvan, V.S.Kumar, M.Jayachandran	Surface Engineering 26 (2010) 555-561	0.432	7
130.	Preparation of anatase TiO_2 thin films for dye-sensitized solar cells by DC reactive magnetron sputtering technique	V.Senthil kumar, M.Jayachandran, C.Sanjeeviraja	Thin Solid Films 519 (2010) 991-994	1.727	18
129.	Effects of annealing temperature on structural, optical, and electrical properties of antimony-doped Tin oxide thin films	V.Senthil kumar, P.Vickraman, JJ.Prince, M. Jayachandran, C. Sanjeeviraja	Philosophical Magazine Letters 90 (2010) 337-347	1.262	14
128.	Fabrication techniques and materials properties of dielectric MgO thin films- A status review	A.M.E Raj M. Jayachandran, C. Sanjeeviraja	CIRP Journal of Manuf. Sci. Technol. 2 (2010) 92-113		14
127.	Structural, optoelectronic and electrochemical properties of nickel oxide films	B.Subramanian, Mohammed Ibrahim, K.R.Murali, V.S.Vidya,	J.Materials Science:Materials in Electronics 20 (2009) 953-957	0.93	9

		C.Sanjeeviraja, M.Jayachandran			
126.	Crystal Structure and thermal characterization of Cadmium oxalate [$CdC_2O_4.3H_2O$] and barium doped cadmium oxalate [$Ba_{0.5}Cd_{0.5}(C_2O_4).5H_2O$] single crystals grown in silica gel	A. Moses Ezhil Raj, D.Deva Jayanthi, V.Bena Jothy, M.Jayachandran, C.Sanjeeviraja	Inorganica Chimical Acta 362 (2009) 1535-1540	1.899	6
125.	Optimized deposition and characterization of nanocrystalline Mg-In Oxide thin films for Opto-electronic applications	A. Moses Ezhil Raj, C.Ravidhas, R.Ravishankar, A.Rathish Kumar, G. Selvan, M.Jayachandran, C.Sanjeeviraja	Materials Research Bulletin 44 (2009) 1051-1057	0.944	5
124.	Effect of Substrate Temperature on structural and material properties of Zirconium nitride films on D9 steel substrates	K.Ashok, B.Subramanian, P.Kuppusamy, M.Jayachandran	Cryst. Res. Technol. 44 (2009) 511-516	0.95	9
123.	Polyvinylidenefluoride (PVdF) based novel polymer electrolytes complexed with $Mg(ClO_4)_2$	P.Vickraman, V.Aravindan, T.Srinivasan, M.Jayachandran	Eur. Phys. J. Appl Phys 45 (2009) 11101 (pp.1-5)	0.899	1
122.	Evaluation of Corrosion and wear resistance Titanium Nitride coated on mild steel (MS) with brush plated nickel interlayer	B.Subramanian, K.Ashok, K.Subramanian, D.Sastikumar, M.Jayachandran	Surface Engineering 25 (2009) 890-895	0.633	10
121.	Molybdenum oxide (MoO_3) thin films based electrochromic cell characterization in 0.1 M $LiClO_4$.PC electrolyte	R.Sivakumar, K.Shanthakumari, A.Thayumanavan M.Jayachandran, C..Sanjeeviraja	Surface Engineering 25 (2009) 548-554	0.633	
120.	Ultrasonic study on binary mixture containing dimethyl formamide and methanol over the entire miscibility range ($0<x<1$) at temperatures 303-323	A. Moses Ezhil Raj, L.B.Reshmi, V.Bena Jothy, M.Jayachandran, C.Sanjeeviraja	Fluid Phase Equlibria 281 (2009) 78-86		17
119.	Amorphous to crystalline transition and optoelectronic properties of nanocrystalline ITO films sputtered with high RF power at room temperature	V. Malathy, S. Sivaranjani, VS.Vidhya, J. Joseph Prince, T. Balasubramanian, C. Sanjeeviraja , M.Jayachandran	J. Non Cryst. Solids 355 (2009) 1508-1516	1.252	17
118.	Effect of embedded lithium nanoclusters on structural, optical and electrical characteristics of MgO thin films	A. Moses Ezhil Raj, V. Bena Jothy, C. Ravidhas, T. Som, M.Jayachandran, C.Sanjeeviraja	Radiation Physics and Chemistry 78 (2009) 914-921	1.149	5
117.	Materials properties of electrodeposited NiFe and NiCoFe coatings	B.Subramanian, K.Govindan, V.Swaminathan, M.Jayachandran	Trans. of the Inst. of Metal Finishing 87 (2009) 325-	1.62	2
116.	Magnesium Indium Oxide ($M_gIn_2O_4$)spinel thin films: chemical spray pyrolysis (CSP) growth and materials characterizations	A. Moses Ezhil Raj, G. Selvan, M.Jayachandran, C.Sanjeeviraja	J. of Colloid and Interface Science 328 (2008) 396-401	3.019	5

115.	Effect of substrate temperature on the structural properties of magnetron sputtered titanium nitride thin films with brush plated nickel interlayer on MS	B. Subramanian, K.Ashok, M.Jayachandran	Applied Surface Science 255 (2008) 2133-2138	1.616	21
114.	The influence of substrate temperature on the electrical properties of ZnO films prepared by the RF magnetron sputtering technique	K.Saravanakumar, V.Senthilkumar, M.Jayachandran, C.Sanjeeviraja, V.Ganesan, Raushan B. Kaizhaiganova, T.Vasudevan, M.S.Lee	Nano: Brief Reports and Reviews 3 (2008) 469-476		1
113.	Studies on transparent spinel magnesium indium oxide thin films prepared by chemical spray pyrolysis	A. Moses Ezhil Raj, V.Senthikumar, V.Swaminathan, Joachim Wollschlager, M.Suendorf, .Neumann, M.Jayachandran, C.Sanjeeviraja	Thin Solid Films 517 (2008) 510-516	1.727	11
112.	Synthesis and characterization of spray pyrolysed $MgIn_2O_4$ spinel thin films for novel applications	A.Moses Ezhil raj, B.Subramanian, V.Senthil kumar, M.Jayachandran, C.Sanjeeviraja	Physica E: Low Dimen. Systems and Nano structures 40 (2008) 467 – 473	1.177	1
111.	High temperature grown transition metal oxide thin films tuning physical properties by MeV N^+ - ion bombardment	R.Sivakumar, C.Saneeviraja, M.Jayachandran R.Gopalakrishnan, S.N.Sarangi, D.Paramanik, T.Som	J.Phys.D:Appl.Phys. 41 (2008) art. No.125304 467 - 473	2.083	5
110.	Growth mechanism and optoelectronic properties of nanocrystalline In_2O_3 films prepared by chemical spray pyrolysis of metal-organic precursor	A.Moses ezhil raj, K.C.Lalithambika, V.S.Vidhya, G.Rajagopal, A.ThayumanavanM.Jayachandran, C.Sanjeeviraja	Physica B: Condensed Matter. 403 (2008) 544-554	1.056	42
109.	Influence of metal organic and inorganic precursors on spray pyrolyzed ceramic MgO (200) thin films for epitaxial over layers	A.Moses Ezhil Raj, K.Vijayalakshmi, G.Selvan, M.Jayachandran, C.Sanjeeviraja	J. Non Cryst. Solids 354 (2008) 3773 – 3779	1.252	4
108.	Growth aspects of barium oxalate monohydrate single crystals in gel medium	A.MosesEzhil raj, D.Deva Jayanthi,V.Bena Jothy, M.Jayachandran, C.Sanjeeviraja	Cryst. Res. Technol. 43 (2008) 1307 – 1313	0.896	3
107.	Characterization of reactive DC magnetron sputtered TiAlN thin films	B.Subramanian, K.Ashok, P.Kuppusamy, C.Sanjeeviraja, M.Jayachandran	Cryst. Res. Technol. 43 (2008) 1078 – 1082	0.896	7
106.	Reactive DC Magnetron Sputtered Zirconium Nitride (ZrN) thin film and its characterization	B.Subramanian, K.Ashok, P.Kuppusamy, C.Sanjeeviraja, M.Jayachandran	J. of Physics: Conference Series 114 (2008) 012039 (9 pp)		2
105.	Materials properties of nanostructured titanium nitride thin films synthesized by DC reactive magnetron sputtering	B.Subramanian, M.Jayachandran	Trans. Insti. Metal Finishing 86 (2008) 62 - 65	1.736	
104.	Structure, Mechanical and Corrosion properties of DC reactive magnetron sputtered Aluminium Nitride (AlN) hard coatings on mild	B. Subramanian, K.Ashok, M.Jayachandran	J.Applied Electrochemistry 38 (2008) 619 – 625	1.697	2

	steel substrates				
103.	Electrochemical corrosion behavior of magnetron sputtered TiN coated steel in simulated bodily fluid and its hemocompatibility	B. Subramanian, M.Jayachandran	Materials Letters 62 (2008) 1727 – 1730	1.94	13
102.	Optoelectronic and electrochemical properties of NiO films deposited by DC magnetron sputtering technique	B.Subramanian, M.Mohamed Ibrahim, V.Senthil Kumar,K.R.Murali, C.Sanjeeviraja, M.Jayachandran	Physica.B: Condensed Matter. 402 (2008) 4104 - 4110	1.056	48
101.	Properties of ZnSe films pulse electrodeposited in the presence of phosphotungstic acid	K.R.Murali,V.S.Vidya, M.Jayachandran	Ionics 14 (2008) 569 – 575	0.899	
100.	Synthesis and characterization of copper substituted lithium manganate spinels	K.R.Murali,T.Saravanan, M.Jayachandran	J.Materials Science:Materials in Electronics 19 (2008) 533 – 537	0.93	8
99.	Tailoring optical and electrical properties of MgO thin films by 1.5 MeV H^+ implantation to fluences	A.Moses Ezhil Raj, T.Som, V.Ganesan, M.Jayachandran, G.Selvan, V.Swaminathan, C.Sanjeeviraja	Nucl. Instr and Methods in Phys. Research B 266 (2008) 2564 - 2571	1.156	9
98.	Effect of phosphotungstic acid on the properties of pulse electrodeposited ZnSe films	K.R.Murali, V.S.Vidya, M.Jayachandran	Mat. Sci. Semi. Proc.10 (2007) 155 - 158	0.388	2
97.	Structural and optical properties of electron beam evaporated CdSe thin	J.Suthan Kissinger, M.Jayachandran, K.Perumal, C.Sanjeeviraja	Bull.Mater.Sci 30 (2007) 547-551	0.51	60
96.	Spray pyrolysis deposition and characterization of highly (100) oriented magnesium oxide thin films	A.Moses Ezhil Raj, L.C.Nehru, M.Jayachandran, C.Sanjeeviraja	Cryst. Res. Technol. 42 (2007) 867-875	0.896	46
95.	Coloration and bleaching mechanism of tungsten oxide thin films in different electrolytes	R.Sivakumar, K.Shanthakumari, A.Thayumanavan, M.Jayachandran, C.Sanjeeviraja	Surf.Engg. 23 (2007) 373-379	0.432	3
94.	Synthesis and materials properties of transparent conducting In_2O_3 films prepared by sol-gel-spin coating technique	E.Savarimuthu, K.C.Lalithambika, A.Moses Ezhil Raj, L.C.Nehru, S.Ramamurthy, A.Thayumanavan, M.Jayachandran, C.Sanjeeviraja	J.Phys.Chem.Solids 68 (2007) 1380-1389	1.189	25
93.	Optoelectronic properties of nano crystalline F-doped SnO_2 (FTO) films prepared by sol-gel spin technique	N.Sankarasubramanian, K.Shanthakumari, V.S.Vidhya, L.C.Nehru, B.Subramanian, A.Thayumanavan, S.Ramamurthy, C.Sanjeeviraja, M.Jayachandran	Optoelectronics and advanced materials Rapid communications 1 (2007) 417-424	0.451	1
92.	Characterization of reactive magnetron sputtered nanocrystalline Titanium Nitride (TiN) thin films with Brush plated Ni interlayer	B. Subramanian, M.Jayachandran	J. Applied Electrochemistry 37 (2007) 1069-1075	1.697	16

91.	Properties and corrosion behavior of reactive magnetron sputtered TiAlN coatings on AISI 316 LSS in simulated bodily fluid	B. Subramanian, G.Umamaheswari M.Jayachandran	Corrosion Engg.Sci & Tech. 42 (2007) 349-355	0.632	4
90.	Structural and electrochemical characterization of Ni nanostructure films on steels with brush plating and sputter deposition	B.Subramanian, S.Mohan, Sobha Jayakrishnan, M.Jayachandran	Current Applied Physics 7 (2007) 305-313	1.586	16
89.	Photoacoustic studies on optical and thermal properties of p-type and n type nanostructured porous silicon for (100) and (111) orientations	R.Srinivasan, M.Jayachandran Ramachandran	Cryst. Res. Technol. 42 (2007) 266-274	0.896	15
88.	MeV N^+-ion irradiation effects on α-MoO_3 thin films	R.Sivakumar, C.Sanjeeviraja, M.Jayachandran R.Gopalakrishnan, S.N.Sarangi, D.Paramanik, T.Som	J. Appl. Physics 101 (2007) 034913-(1-5)	2.072	16
87.	Modification of WO_3 thin films by MeV N^+-ion beam irradiation	R.Sivakumar, C.Sanjeeviraja, M.Jayachandran, R.Gopalakrishnan, S.N.Sarangi, D.Paramanik, T.Som	J.Phys.CondenseM Matter 19 (2007) 186204 (9pp)	0.964	12
86.	Characterization on electron beam evaporated α-MoO_3 thin films by the influence of substrate temperature	R.Sivakumar, R.Gopalakrishnan, M.Jayachandran C.Sanjeeviraja	Current Applied Physics 7 (2007) 51 - 59	1.586	36
85.	An Electrochromic device (ECD) cell characterization on electron beam evaporated MoO_3 films by intercalating/ deintercalating the H^+ ions	R.Sivakumar, C.S.Gopinath, M.Jayachandran, C.Sanjeeviraja,	Current Applied Physics 7 (2007) 76 – 86	1.586	25
84.	Preparation and characterization of electron beam evaporated WO_3 thin films	R.Sivakumar, R.Gopalakrishnan M.Jayachandran,	Optical Materials 29 (2007) 679-687	1.728	62
83.	Biodiesel production from vegetable oils by alkali catalyzed methanolysis method	D. Jayaperumal, S.T.Selvamani, T. Selvaganapathy ,A. Madhava Mayandi, M. Jayachandran	Bull. Electrochemistry 23 (2007) 231-236	-	
82.	Production of biodiesel from different vegetable oils by alkali catalyzed transesterification	D. Jayaperumal, S.T.selvamani, T.Selvaganapathy, A. Madhava Mayandi, M. Jayachandran	Bull. Electrochemistry 23 (2007) 217-222		
81.	Development of a novel high optical quality ZnO thin films by PLD for III–V opto-electronic devices	K.Ramamoorthy, C.Sanjeeviraja, M.Jayachandran, K.Sankaranarayanan, Pankaj Misra, L.M. Kukreja	Current Applied Physics 6 (2006) 103-108	1.586	63
80.	Preparation and characterization of nanostructured Tin oxide (SnO_2) films by sol-gel spin coating technique	E.Savarimuthu, N.Sankarasubramanian, B.Subramanian, M.Jayachandran, C.Sanjeeviraja, S.Ramamoorthi	Surface Engineering 22 (2006) 268-276	0.432	8
79.	Surface characterization	B.Subramanian,	Surface Engineering		

	studies of nickel-chromium PVD:EB evaporated on low carbon steel samples	M.Jayachandran S.Jayakrishnan	22 (2006) 447-451	0.432	2
78.	Investigation on the X-Ray Photoelectron Spectroscopic (XPS), cyclic voltammetric analyses of WO_3 films and their electrochromic response in FTO/EC/ Electrolyte/FTO cells	R.Sivakumar, M.Jayachandran, V. Vijayan, C. Sanjeeviraja	Smart Materials and Structures 15 (2006) 877-888	0.432	33
77.	Intercalation studies on electron beam evaporated MoO_3 films for electrochemical devices	R.Sivakumar, P.Manisankar M.Jayachandran, C..Sanjeeviraja	Solar Energy Mat. and Solar Cells 90 (2006) 2438-2448	3.858	21
76.	Particle size analysis of Barium Titanate powder by slow-rate sol-gel process route	R. Balachandran, H.K. Yow, M. Jayachandran , W.Y.W. Yusof, V. Saaminathan	IEEE IntL. Conf. on Semi conductor Elec., proc., ICSE, art. No. 4266641, (2006) 406-409		1
75.	Characterization of WO_3 films prepared at different deposition currents on CTO substrates	R.Vijayalakshmi, M.Jayachandran C.Sanjeeviraja	Synthesis & Reactivity in Inorg.,Metal Org. & Nanometal chem.. 36 (2006) 89-94	0.569	4
74.	Sequential deposition of Cu-Ni by Electron beam evaporation and its characterization	B.Subramanian, M.Jayachandran Sobha Jayakrishnan	Transaction of the Institute of Metal Finishing 84 (2006) 52–55	1.376	
73.	Pulsed electrodeposition and characterization of molybdenum diselenide thin film	S.Mary Delphine, M.Jayachandran C.Sanjeeviraja	Mater. Res. Bull 40 (2005) 135-147		22
72.	Particle induced X-ray emission spectroscopic (PIXE) and surface morphological (AFM) studies on electron beam evaporated WO_3 films	R.Sivakumar, V.Ganesan V.Vijayan M.Jayachandran C.Sanjeeviraja	Surface Engineering 21 (2005) 315-319	1.879	2
71.	A novel nano-architecture for ZnO thin films on <100> Si, GaAs and InP single crystal wafers by L-MBE as value in nano-robotic(machining) device fabrication efforts	K.Ramamoorthy, C.Sanjeeviraja M.Jayachandran K.Sankaranarayanan V. Ganesan, Pankaj Misra L.M. Kukreja	Materials Science in Semiconductor Processing 8 (2005) 555 - 563	0.388	9
70.	Electron beam evaporated Mo Oxide Films: a study of elemental and surface morphological properties	R. Sivakumar, V. Vijayan, V.Ganesan M.Jayachandran C.Sanjeeviraja	Smart Materials and Structures 14 (2005) 1204-1209	0.432	11
69.	Studies on nickel electrodeposits on dc magnetron sputtered copper substrates	B.Subramanian, S.Jayakumar M.Jayachandran Sobha Jayakrishnan	Surface Engineering 21 (2005) 151-155	0.432	1
68.	Characterization of Brush plated Sn and SnSe	B.Subramanian, S.Jayakumar M.Jayachandran S.Mohan, Sobha Jayakrishnan	Indian Surface Finishing 2 (2005) 64-68		
67.	Review on WO_3 thin films: Materials properties, preparation techniques and	M.Jayachandran, R. Vijayalakshmi, Visalakshi Ravindran, C.Sanjeeviraja	Transactions of the SAEST 40 (2005) 42-61		2

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66.	Development of a novel high speed (electron-mobility) epi-ZnO thin films by L-MBE for III-V opto-electronic devices	K.Ramamoorthy, M.Jayachandran K.Sankaranarayanan , Pankaj Misra,L M Kukreja, C.Sanjeeviraja	Current Applied Physics 4 (2004) 679-684	1.74	9
65.	Epitaxial lattice matching between epi-n-IZO thin films and <100> Si, GaAs and InP wafers with out any buffer layers by L-MBE technique a novel development for III-V opto - electronic devices	K.Ramamoorthy, C.Sanjeeviraja M.Jayachandran K.Sankaranarayanan , Pankaj Misra L M Kukreja,	Materials Chemistry and Physics 84 (2004) 14 – 19		10
64.	Fabrication of novel nano-architecture for IZO thin flims on <100> Si, GaAs and InP single crystal wafers by L-MBE	K.Ramamoorthy, C.Sanjeeviraja M.Jayachandran K.Sankaranarayanan , Pankaj Misra,L M Kukreja,	Surface Engineering 20 (2004) 205-210	0.633	1
63.	Preparation and characterization of spray deposited n-type WO_3 thin films for electrochromic devices	R.Sivakumar,A.Moses Ezhil Raj, B.Subramanian, M.Jayachandran D.C.Trivedi, C.Sanjeeviraja	Materials Research Bulletin 39 (2004) 1479-89		71
62.	Effect of annealing on structural surface and optical properties of α - MoO_3 thin films by PVD:EBE for electrochromic devices	R.Sivakumar, M.Jayachandran C.Sanjeeviraja	Surface Engineering 20 (2004) 385-390	0.633	8
61.	Study of the potassium ion insertion of the electrodeposited electrochromic tungsten trioxide thin films	R.Vijayalakshmi, M.Jayachandran, D.C.Trivedi, C.Sanjeeviraja	Ionics 10 (2004) 151-154		6
60.	Studies on the effect of substrate temperature on (VI-VI) textured tungsten oxide (WO_3) thin films on glass, SnO_2:F substrates by PVD:EBE technique for electrochomic devices	R.Sivakumar M.Jayachandran C.Sanjeeviraja	Materials Chemistry and Physics 87 (2004) 439-445		31
59.	Epi-n-IZO thin films/<100> Si, GaAs and InP by L-MBE – a novel feasibility study for SIS type Solar cells	K.Ramamoorthy, C.Sanjeeviraja M.Jayachandran K.Sankaranarayanan , Pankaj Misra,.L M. Kukreja,	Solar Energy 77 (2004) 193-201		9
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57.	Preparation and characterization of tin diselenide thin film by spray pyrolysis technique	L.Amalraj M.Jayachandran C.Sanjeeviraja	Materials Research Bulletin 39 (2004) 2193-2201		19
56.	A study of sequentially evaporated Nickel Aluminum coatings	B.Subramanian, M.Jayachandran, Sobha Jayakrishnan	Electrochemical Society of India 53 (2004) 75		
55.	Photoelectrochemical characteristics of brush plated tin sulfide thin films	B.Subramanian, M.Jayachandran, C.Sanjeeviraja	Solar Energy Materials and Solar Cells 79 (2003) 57-65		38

54.	Epi-n-ZnO/<100> Si, GaAs and InP by L-MBE: a novel approach for III–V devices	K.Ramamoorthy, C.Sanjeeviraja M.Jayachandran K.Sankaranarayanan , Pankaj Misra L M Kukreja,	Materials Sci. in Semiconductor Processing 6 (2003) 219-224		14
53.	Pulsed electrodeposition and characterisation of tungsten diselenide thin films	S.Mary Delphine, M.Jayachandran C.Sanjeeviraja	Materials Chemistry and Physics 81 (2003) 78-83		28
52.	Materials properties of electrodeposited $SnS_{0.5}Se_{0.5}$ films and characterization of photoelectrochemical solar cells	B.Subramanian, M.Jayachandran, C.Sanjeeviraja	Materials Research Bulletin 38 (2003) 899-908		13
51.	Structural, electrochromic and FT-IR studies on electrodeposited tungsten trioxide films	R.Vijayalakshmi, M.Jayachandran, C.Sanjeeviraja	Current Applied Physics 3 (2003) 171-175		41
50.	Influence of alloying additives on the performance of commercial grade aluminium as galvanic anode in alkaline zincate solution for use in primary alkaline batteries	M.Paramasivam, M.Jayachandran,S.Venkatakrishna Iyer	Journal of Applied Electrochemistry 33 (2003) 303-309		25
49.	Electrosynthesis and characterisation of n-WSe_2 thin films	J.Jebaraj Devadasan, C.Sanjeeviraja M.Jayachandran	Materials Chemistry and Physics 77 (2003) 397-401		21
48.	Spray pyrolysis growth and material properties of In_2O_3 films	J.Joseph Prince, S.Ramamurthy B.Subramanian, C.Sanjeeviraja M.Jayachandran	Journal of Crystal Growth 240 (2002) 142-151		88
47.	Spray pyrolysised tin disulphide thin film and characterization	L.Amalraj, C.Sanjeeviraja, M.Jayachandran	Journal of Crystal Growth 234 (2002) 683-689		35
46.	Brush plating of tin(II) selenide thin films	B.Subramanian, M.Jayachandran, C.Sanjeeviraja	Journal of Crystal Growth 234 (2002) 421-426		75
45.	Review on materials properties of Sn(S, Se) compound semiconductors useful for photoelectrochemical solar cells	B.Subramanian, C.Sanjeeviraja, M.Jayachandran	Bull. Electrochemistry 18 (2002) 349-366		10
44.	Ce^{3+} doped stillwellites: a new luminescence system with strong ion lattice coupling	L.C.Nehru, K.Marimuthu, M.Jayachandran, Chung-Hsin Lu, R.Jagannathan	J. Physics D: Applied Physics 34 (2001) 2599-2605		17
43.	Cathodic electrodeposition and analysis of SnS films for photoelectrochemical cells	B.Subramanian, C.Sanjeeviraja, M.Jayachandran	Mat. Chem. and Phys. 71 (2001) 40-46		82
42.	Electrodeposition of p-WS_2 thin film and characterization	T.Joseph Sahaya Anand , C. Sanjeeviraja, M.Jayachandran	J. of Crystal Growth 226 (2001) 67-72		22
41.	Synthesis of porous silicon Nanostructures for photoluminescence	M.Jayachandran, M.Paramasiam, K.R.Murali, D.C.Trivedi, M.Raghavan	Materials Physics and Mechanics 4 (2001) 143-147		44
40.	Preparation and characterization of ZnO thin films on InP by laser-molecular beam	K.Ramamoorthy, C.Sanjeeviraja, M..Jayachandran, K.Sankaranarayanan,Pijush	Journal of Crystal Growth 226 (2001) 281-286		36

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39.	Studies on the brush plated SnS thin films	M.Jayachandran, S.Mohan, B.Subramanian, C. Sanjeeviraja	J. Mater. Sci. Lett. 20 (2001) 381-383		21
38.	Galvanostatic deposition and characterization of cuprous oxide thin films	T.Mahalingam, J.S.P.Chitra, S.Rajendran, M.Jayachandran, Mary Juliana Chockalingam	Journal of Crystal Growth 216 (2000) 304-310		68
37.	Preparation of layered semiconductor ($MoSe_2$) by electrosynthesis	T.Joseph Sahaya Anand, C.Sanjeeviraja, M.Jayachandran	Vacuum 60 (2000) 431-435	0.975	25
36.	Electrodeposition of Sn, Se, SnSe and the material properties of SnSe films	B.Subramanian, T.Mahalingam, C.Sanjeeviraja, M.Jayachandran, Mary Juliana Chockkalingam	Thin Solid Films 357 (1999) 119 -124	1.727	71
35.	Electrochemical synthesis of SnS thin films for photoelectrochemical cells	B. Subramanian, C. Sanjeeviraja, M. Jayachandran Chockalingam,Mary Juliana	Proc. of SPIE –The Intl. Soc. for Optical Engg (1999) 3896, pp.474-482		2
34.	Studies on molybdenum diselenide thin films prepared by electrodeposition technique	Sahaya Anand, T. Joseph, T. Mahalingam, C. Sanjeeviraja, M. Jayachandran, Chockalingam,Mary Juliana	Proceedings of SPIE- The International Soceityfor Optical Engineering (1999) 3789, pp.125-130		1
33.	New transparent electronic conductor $MgIn_2O_4$ spinel	E.Dali, M.Jayachandran, Mary Juliana Chockalingam	J. Mat. Sci. Lett. 18 (1999) 915-917		13
32.	Electrodeposition of Sn, Se, SnSe and the materials properties of SnSe films	B Subramanian, T Mahalingam, C Sanjeeviraja, M.Jayachandran, Mary Juliana Chockkalingam	Bull. Electrochemistry 14 (1998) 398- 401		11
31.	Electrosynthesis and characterization of $Zn_{1-x}Cd_xSe$ thin films	R.Chandramohan, C.Sanjeeviraja, S.Rajendran, T.Mahalingam, M.Jayachandran, Mary Juliana Chockkalingam	Bull. Electrochemistry 14 (1998) 402-406		1
30.	Synthesis and characterization of semiconducting oxide $MgIn_2O_4$ powder	M.Jayachandran, E.Dali, Mary Juliana Chockalingam	Bull. Electrochemistry 14 (1998) 283 – 285		
29.	Galvanostatic deposition of Cu_2O layers through the electrogeneration of base route	T.Mahalingam, C.Sanjeeviraja, M.Jayachandran, Mary Juliana Chockalingam	J. Mat. Sci. Letters 17 (1998) 603-605		3
28.	Synthesis and characterization of AIn_2O_4 indates, A = Mg, Ca, Sr, Ba.	E.Dali, M.Jayachandran, Mary Juliana Chockalingam	J.Mater. Sci. Lett. 17 (1998) 619 – 623		28
27.	Materials properties of transparent conducting $MgIn_2O_4$ powder	M. Jayachandran, S.E.Dali, M.J. Chockalingam, A.S.Lakshmanan	Proc. of SPIE- The Int. Society for Optical Eng. (1997) 3138, pp.173-179.		1
26.	Electrochemical preparation and charcterization of copper indium diselenide thin films	R.Jeyakumar, S. Ramamurthy, M.Jayachandran, Mary Juliana Chockalingam	Materials Research Bulletin 29 (1994) 195-202		9
25.	Properties of Cd_2SnO_4 conducting powder for ohmic contacts	M.Jayachandran, Mary Juliana Chockalingam, A.S. Lakshmanan	J. Materials Science Letters 13 (1994) 618-620		
24.	Studies on Cd_2SnO_4 thick layers prepared by	M.Jayachandran, Mary Juliana Chockalingam, A.S.	J. Materials Science Letters		

	the squeezing and sintered technique	Lakshmanan	13 (1994) 386-388		
23.	Cd_2SnO_4 – its sol-gel preparation and materials properties	M.Jayachandran, B. Subramanian, Mary Juliana Chockalingam, A.S.Lakshmanan	Bull. Mater. Sci. 17 (1994) 989-997		8
22.	Cd_2SnO_4 – A new semiconductor oxide negative active material for secondary rechargeable batteries	M.Jayachandran, S.Jagannathan, Mary Juliana Chockalingam, A.S. Lakshmanan	Bull. Electrochemistry 9 (1993) 290-292		1
21.	$CuInSe_2$ for photovoltaics - A critical assessment	M.Jayachandran, Mary Juliana Chockalingam, K.R. Murali, A.S. Lakshmanan	Mater. Chem. Phys. 34 (1993) 1-13		12
20.	X-ray and scanning electron microscope studies on electrodeposited ZnCdS semiconductor alloys	M. Jayachandran V.K. Venkatesan	Proc. of SPIE-The International Societyfor Optical Engineering (1990) 1284, pp.260-266		1
19.	Electrodeposition and optical properties of $Zn_xCd_{(1-x)}S$ thin films useful for solar cells	M.Jayachandran, V.Vinni, Mary Juliana Chockalingam, V. Subramanian, T.Mahalingam	Bull. Electrochemistry 6 (1990) 433-434		
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16.	Electrodeposition and materials characterisation of CdS thin films on Ti, Al and SnO_2 conducting glass	M.Jayachandran, Mary Juliana Chockalingam, V.K. Venkatesan	J. Mat. Sci. Letters 8 (1989) 563-565		9
15.	Characteristic of electrodeposited SnO_2-CdS/Au Schottky devices	M.Jayachandran, Mary Juliana Chockalingam, V.K. Venkatesan	Physica Status Solidi (a) 113 (1989) K 217-221		
14.	PC based test system for online characterization of solar cell modules	M.Jayachandran, G.Radahakrishnan, Thirumalai Parthiban, R.Kalidoss, A.Sundaraja, Mary Juliana chockalingam,	Proceedings of SPIE-The International Society for Optical Engineering 1149(1989)15-21		
13.	Electrodeposition of CdS thin films from aqueous solution on Pt, Ti, Al and SnO_2 substrates	M.Jayachandran, Mary Juliana Chockalingam, V.K. Venkatesan	Bull Electrochemistry 5 (1989) 848		
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10.	Computer aided characterization of solar cell from a single illuminated current (I) voltage (V) curve	M.Jayachandran, S.P. Manoharan, Mary Juliana Chockalingam	BullElectrochemistry 4 (1988) 281-283		
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7.	Review of Techniques on growth of GaAs and related compounds	K.R. Murali, M.Jayachandran N.Rangarajan	BullElectrochemistry 3 (1987) 261		6
6.	Optical characterisation of chemically deposited Cu_2S layer for thin film CdS/Cu_2S solar cells	M.Jayachandran, Mary Juliana Chockalingam, K.Nagarja Rao, I.Radhakrishna, N.Rangarajan	BullElectrochemistry 2 (1986) 303-304		
5.	Fabrication of Cu_2S-CdS solar cell using screen printed CdS layers	M.Jayachandran, Mary Juliana Chockalingam, K.Nagaraja Rao, I.Radhakrishna, N.Rangarajan	BullElectrochemistry 2 (1986) 181-183		3
4.	Logarithmic I-V plotter for solar cell characterization	K.R.Ramakrishnan, S.Panjali, M.Jayachandran, Mary Juliana Chockalingam, Y. Mahadeva Iyer	Bull. lectrochemistry 2 (1986) 515-518		
3.	Design and optimisation of a contact grid pattern for circular Cu_2S/CdS solar cells – A Case Study	M.Jayachandran, Mary Juliana Chockalingam	Bull lectrochemistry 2 (1986) 83-86		
2.	Spectroelectrochemistry of aqueous solutions	M.Jayachandran	CorrosionBull.4 (1984) 241-250		
1.	Brightness, polarization and electron density of the solar corona of 1980 February 16	K.R. Sivaraman M. Jayachandran KK. Skaria, G.S.D. Baba SP. Bangare, AP. Jayarajan	J.Astrophysics andAstronomy 5, pp 561-5671984		

ANNEXURE – III

Papers Presented in Conferences/Published in Proceedings: 68

68	Synthesis of ZnO-TiO2 and its photo activity for degradation of RhB N. Geetha, M. Kashif. S. Sivaranjani, D. Saravanakkumar, A. Ayeshariam, M. Jayachandran International Conference on recent Trends in Materials (ICRTM-2014) held at Devanga Arts College, Aruppukottai during Dec.22 & 23, 2014
67	Physical and Optical properties of Annealed Electron Beam Evaporated CdSe Thin Films S. Rani, J. Shanthi, <. Kashif, Sahid Hussain, A. Ayeshariam, M. Jayachandran International Conference on recent Trends in Materials (ICRTM-2014) held at Devanga Arts College, Aruppukottai during Dec.22 & 23, 2014
66	Pulsed Magnetron sputtered TiCrN Superhard coatings on steels for cutting tool applications R. Muralikrishnan, V.V.Anusha Thampi, B. Subramanian, M. Jayachandran International Conference on recent Trends in Materials (ICRTM-2014) held at Devanga Arts College, Aruppukottai during Dec.22 & 23, 2014
65	Bio Synthesis of SnO2 Nanostructured Materials for bacterial and fungal activities R. Thirumamagal, M. Jayachandran, M. Bououdina, A. Ayeshamariam International Conference on recent Trends in Materials (ICRTM-2014) held at Devanga Arts College, Aruppukottai during Dec.22 & 23, 2014
64	Fabrication and characterization of pulsed magnetron sputtered Ti-Si-N nanosuperhard coatings on steels J.Balaraman, V.V.Anusha Thampi, B. Subramanian, M. Jayachandran International Conference on recent Trends in Materials (ICRTM-2014) held at Devanga Arts College, Aruppukottai during Dec.22 & 23, 2014
63	Evaluation of ZnO based DSSC with blocking layer by pulsed laser deposition and porous layer by chemical method Vijayalakshmy S, B.Subramanian, **M.Jayachandran** 2nd TAPSUN meeting, Chennai during Sept. 13-14, 2013
62	Characterization of Ti-Si-N nanocomposites super hard thin films on bio implantable substrates by reactive dc magnetron sputtering V.V.Anusha Thampi, **M.Jayachandran**, B.Subramanian 2nd International Conference on Advanced Functional Materials –ICAFM 2014, Thiruvananthapuram during 19-21 February 2014
61	Sputtered Zr–Cu–Al–Ag Thin Film Metallic Glass on SS 316 L and its Characterization for Implants B.Subramanian, S.ThankaRajan, A.K.Nandakumar, A. Kobayashi, S. Yugeswaran, **M. Jayachandran** Proc. The 7th International Workshop on Plasma Application and Hybrid Functionally Materials, Hong Kong during March 7 - 10, 2014
60	Shape-selective magnetic Cobalt Oxide Nanowires: Environmental Application in Catalysis Studies S. Kundu and **M. Jayachandran** National Convention of Electrochemists (NCE-17) held at B.S.Abdur Rahman University, Chennai during September 14-15, 2012
59	Nano structured SnO_2 thin film electrodes by Sol-gel method for Dye Sensitized Solar Cells B. Subramanian, V.S. Vidhya, **M. Jayachandran** International Conference on Recent Advances in Textile and Electrochemical Sciences-2013 (RATE 2013) held at Alagappa University, Karaikudi during March 21-23, 2013 (p.120).
58	Size and Shape-selective formation of catalytically active cobalt oxide nanomaterials by microwave heating **M. Jayachandran**, Subrata Kundu International Conference on Recent Advances in Textile and Electrochemical Sciences-2013 (RATE 2013) held at Alagappa University, Karaikudi during March 21-23, 2013 (p.15).
57	Enhanced catalytic SERS activities of DNA template Au nanowires synthesized using Self-assemble Au Nanoparticles Subrata Kundu, **M. Jayachandran** International Conference on Recent Advances in Textile and Electrochemical Sciences-2013 (RATE 2013) held at Alagappa University, Karaikudi during March 21-23, 2013 (p.92).
56	Synthesis and Characterization of ZnO-Aloevera nanocomposites useful for Antibacterial activities

	V.S. Vidhya, R. Perumal Samy, A. Ayeshamariam, **M, Jayachandran** International Conference on Recent Advances in Textile and Electrochemical Sciences-2013 (RATE 2013) held at Alagappa University, Karaikudi during March 21-23, 2013 (p.141).
55	Synthesis of carbon nanotubes (CNTS) using novel bimetallic catalyst for DSSC and cobalt oxide (CoO) nanowires using microwave heating for dye mineralization **M. Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (ISAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013 (p.33).
54	Development of high performance counter electrodes using carbon nanotubes grown over novel 3D cubic bimetallic Fe-Co-KIT-6 for dye sensitized solar cells J. Balamurugan, R. Thangamuthu, A. Pandurangan, **M. Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (ISAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013 (p.100).
53	Fabrication of TiO_2/FTO electrodes by reactive magnetron sputtering for dye sensitized solar cells S. Vijayalakshmi, B. Subramanian, **M. Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (ISAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013 (p.100).
52	DNA template self-assembled aggregated Au nanoparticles with superior catalytic and SERs activity Subrata Kundu, **M. Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (ISAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013 (p.115).
51	Fabrication of $Ti_{40}Cu_{36}Pd_{14}Zr_{10}$ thin film metallic glasses by sputtering and their characterization for bio implant applications B. Subramanian, S. Mohan, **M. Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (ISAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013 (p.140).
50	Characterization of ZnO/PSi heterostructures formed by electrochemical etching and sol-gel spin coating technique V.S.Vidhya**,** B.Subramanian, R. Thangamuthu, **M.Jayachandran** 10th International Symposium on Advances in Electrochemical Science and Technology (iSAEST-10) held at Hotel Green Park, Chennai organized by SAEST and CSIR-CECRI, Karaikudi during 28-30th January 2013.
49	Studies on nanocrystalline SnO_2 films prepared by the sol-gel spin coating technique V.S.Vidhya , B.Subramanian, **M.Jayachandran** National Seminar on Current Trends in Material Science & Nanostructured Materials (CTMN 2013) held at Cauvery College For Women, Annamalai Nagar, Tiruchirappalli during 23rd and 24th January 2013.
48	Sputtered $Zr_{48}Cu_{36}Al_8Ag_8$ glassy metals on steels for bio implants B.Subramanian, S.Silveriya and **M.Jayachandran** National Convention of Electrochemists (NCE-17) held at B.S.Abdur Rahman University, Chennai during September 14-15, 2012
47	Size-Controllable Synthesis of ITO Nanoparticles and Application in Gas sensor devices A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** International Conference on Recent Trends in *Advanced Materials (ICRAM-2012)* held at School of Advanced Sciences, VIT University, Vellore during 20-22, February 2012.
46	Tribological properties and bioactivity of plasma sprayed YSZ reinforced hydroxyapatite coatings on steels for implants B.Subramanian **M.Jayachandran** S. Yugeswaran A.Kobayashi 16th National Congress on Corrosion Control, Kolkata during August 23-25 , 2012.
45	"Microstructural and electrochemical properties of reactive magnetron sputtered vanadium nitride thin films", B.Subramanian, R.Ananthakumar, **M.Jayachandran** and Akira Kobayashi, 3rd International Workshop on Plasma Application & Hybrid Functionally Materials (IAPS'10) - Institute of Applied Plasma Science in Frontier of Applied Plasma Technology 4 (2011) pp.25-30.
44	Structural and Morphological Studies of Nanostructured ITO Nanoparticle A.Ayeshamariam, C.Sanjeeviraja, **M.Jayachandran** and L.C.Nehru International Conference on *Advanced Materials (ICAM – 2011),* Department of Physics, PSG College of Technology, Coimbatore during 12–16 December 2011.

43	Synthesization and Characterization of ITO Nanoparticles A. Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** 2nd National Conference on *Recent Advancements in Science and Humanities (RASH 11),* Department of Science and Humanities, United Institute of Technology, Coimbatore, during 18 – 19, March 2011.
42	Materials Properties TiN/TiOXNY Multilayers prepared by plasma ion beam sputtering on 316L SS for bio medical implants B. Subramanian, R. Ananthakumar, S. Yugewaran, **M.Jayachandran** and Akira Kobayashi,8th International Symposium on Applied Plasma Science -ISAPS-11 – September , 26-30, 2011- Advances In Applied Plasma Science , Hakkone JAPAN Vol.8,Year 2011 Pages 133-134 (Received paper Award)
41	Nanocomposite Ti-Si-N coatings deposited by reactive dc magnetron sputtering for biomedical applications R.Ananthakumar,B.Subramanian**,** R.Thangamuthu, Subrata Kundu,**M.Jayachandran** International Conference on Biomaterials and Implants: Prospects and possibilities in the new Millennium (BIO 2011) CGCRI Kolkata July 21-23,2011
40	Nanocrystalline ITO particles from Combustion Synthesis and its Optical Characterization A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** International conference on *Advanced materials and its Applications (ICAMA – 2011)*, Department of Physics and Department of Chemistry, Kalasalingam University, Krishnankoil, during March 4-5, 2011.
39	An Amazing Resource entitled on “Recent Advances in Solar Renewable Energy – the Photovoltaic Challenge” A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** **National Seminar on *Renewable Energy,*** ADM College for Women, Nagapattinam, during January 20 and 21 2011.
38	Application of indium oxide nanoparticles A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** National Conference on Perspectives in LASER Optics Spectroscopy, Bishop Heber College, Tiruchirappalli on 14th February 2011.
37	Structural and Optical characterization of Combustion synthesized indium oxide Nanopowders A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** International Conference (*ICWNMDP- 2011*), School of Physics, Madurai Kamaraj University, Madurai and won the second prize for presentation during 10-12 February, 2011
36	Surface characterization and bio compatibility studies on reactive magnetron sputtered TiN/NbN nanostructured multilayer thin films, B.Subramanian, R.Ananthakumar, C.V.Muraleedharan and **M.Jayachandran**, "*Biomedical Applications of Nanostructured Materials",* V. Rajendran, B. Hillbrands, P. Prabu and G.E. Geckeler (Eds.), Macmillan Publishers India Limited, New Delhi (2010), pp.3-8.
35	Polyaniline-based low-cost counter electrode for dye-sensitized solar cells R. Thangamuthu, B. Subramanian, VS. Vidhya, P. Chithra lekha, K.R. Murali, **M. Jayachandran**, "*Nanostructured Materials for Electronics, Energy and Environmental Applications",* V. Rajendran, B. Hillbrands, K. Thyagarajaiah and G.E. Geckeler (Eds.), Macmillan Publishers India Limited, New Delhi (2010), pp.301-306.
34	B. Subramanian, C.V.Muraleedharan R.Ananthakumar, and **M. Jayachandran**, "Cytotoxicity, Hemocompatibility and corrosion behavior in SBF on Magnetron sputtered Titanium dioxide (TiO_2) coated Bio implants" in the *“Proceedings of International Conference on Recent Trends in Materials Science and Technology (ICMST-2010)*", (2010) pp.2.31 - 2.35.
33	VS.Vidhya, J.Vatsala Rani, R.Ravi kumar, R. Thangamuthu, B.Subramanian, **M.Jayachandran**, "Effect of ionic liquid on the electrodeposition mechanism and properties of nanocrystalline ZnO films" in the *“Proceedings of International Conference on Recent Trends in Materials Science and Technology (ICMST-2010)*", (2010) pp.1.44 - 1.46.
32	Preparation and Characterization of indium oxide nanoparticles A.Ayeshamariam, C.Sanjeeviraja and M.Jayachandran International Conference Advancement of Nanoscience and Technology, Alagappa University Karaikudi during March 1-3, 2010.
31	Structural and spectroscopic characterization of electrodeposited Tin doped Zinc oxide thin films VS.Vidhya, R.Ananthakumar, B.Subramanian, R.Thangamuthu, **M.Jayachandran** International conference on Recent Frontiers in Applied Spectroscopy (ICORFAS- 2010) held at Department of Physics, Annamalai University
30	Studies on Nano-Crystalline Porous Silicon Structure useful for Sensor Development VS.Vidhya, KR.Murali, B.Subramanian, **M.Jayachandran** International Conference on Recent Trends in Sensor-Development for theAssessment and Management of the Environment held at Loyola College, Chennai during 8-10 January 2009
29	Optoelectronic properties of nanostructured In_2O_3:Sn (ITO) films deposited by RF sputtering at

	room temperature VS.Vidhya, B.Subramanian, P.Manisankar, C.Sanjeeviraja, **M.Jayachandran** National Conference on Recent Advances in Surface Engineering (RASE09) held at National Aerospace Laboratories, Bangalore during 26-27 February 2009
28	Effect of current density on the morphological properties of Porous Silicon (PS) prepared by electrochemical anodic etching technique VS.Vidhya, P.Manisankar, C.Sanjeeviraja, **M.Jayachandran** 3rd National Seminar on Advances in Materials Science (NSAMS-2009) held at Department of Physics, Manonmaniam Sundaranar University, Tirunelveli during 16-17 March 2009
27	Studies on Nanocrystalline Silicon Pillars formed on Porous Silicon Matrix VS.Vidhya, P.Manisankar, C.Sanjeeviraja, **M.Jayachandran** National Conference on Nanomaterials for Energy Conversion and Conservation (NMECC-09), Bishop Heber College, Tiruchirappalli on 26 March, 2009.
26	Characterization of Indium Tin Oxide Powdered Particles A.Ayeshamariam, C.Sanjeeviraja and **M.Jayachandran** National seminar on *Nano Materials – Preparation, Characterisation and Devices,* Bishop Heber College, Trichy on 28th March 2009.
25	Electrodeposition of nanocrystalline and optically transparent ZnO thin films J.Vatsala rani,VS.Vidhya, P.Manisankar, C.Sanjeeviraja, **M.Jayachandran** National Conference on Nanomaterials for Energy Conversion and Conservation (NMECC-09), Bishop Heber College, Tiruchirappalli on 26 March, 2009.
24	Studies on porous silicon (PSi) structure prepared by electrochemical anodic etching VS.Vidhya, P.Manisankar, C.Sanjeeviraja, **M.Jayachandran** RATES 2009, Department of Industrial Chemistry, Alagappa University, Dec 2009
23	Zinc Oxide (ZnO) nano crystalline films deposited by pulse plating technique VS. Vidhya, S.Vincent, K.R.Murali, **M.Jayachandran** National Conference on Corrosion Assessment and its Control, Organized by Thiyagaraja College of Engineering, Madurai on 21-22, Dec 2009
22	The influence of substrate temperature on the optical properties of ZnO films prepared by RF Magnetron sputtering technique K.Saravanakumar**, M.Jayachandran**, C.Sanjeeviraja, Proceedings Asian Conference on Solid State Ionics –Bharathiar University 9-12 June 2008, Ed.B.V.R.Chowdari et. al. (2008) 925-931.
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20	Characterization of RF Magnetron sputtered $MgIn_2O_4$ thin films B.Anuradha, **M.Jayachandran**, C.Sanjeeviraja Proceedings Asian Conference on Solid State Ionics –Bharathiar University 9-12 June 2008, Ed.B.V.R.Chowdari et. al. (2008) 941-943.
19	XRD and AFM studies on DC magnetron sputtered nanocrystalline TiO_2 thin film V.Senthilkumar, B.Subramanian, **M.Jayachandran**, C.Sanjeeviraja Proceedings of the 53rd DAE Solid State Physics Symposium 53(2008)731-732
18	Effect of RF power on the characterization of Indium Tin Oxide films S.Sivaranjani, V.Malathy, J.Joseph Prince, T.Balasubramanian, **M.Jayachandran**, C.Sanjeeviraja Proceedings of the 53rd DAE Solid State Physics Symposium 53(2008)731-732
17	Mathematical modeling for thickness optimization of spin coated films N.Sankara Subramanian, **M.Jayachandran,** S.Ramamurthy, R.Krishnamoorthy, S.Srivatsan, B.Santhi. Proceedings of International conference on Optoelectronic Materials and Thin Films for Advanced Technology (OMTAT-2005), Ed M.K.Jayaraj, Cochin University of Science and Technology, Kochi (2005) 541-553
16	Preparation of SnSe and SnS thin film electrodes by brush plating and its characterization for PEC solar cells. B.Subramanian, C.Sanjeeviraja, Sobha Jayakrishnan **M.Jayachandran** Physics of Semiconductor Devices Eds.K.N.Bhat and A.DasGupta, Narosa Publishing House, New Delhi (2004) 250-252.
15	Study of hydrogen diffusion in the electrodeposited tungsten trioxide thin films R.Vijayalakshmi, **M.Jayachandran,** C.Sanjeeviraja Physics of Semiconductor Devices Eds.K.N.Bhat and A.DasGupta, Narosa Publishing House, New Delhi (2004) 250-252.

14	Characterization of spray pyrolysised electrochromic WO_3 thin films R.Sivakumar, **M.Jayachandran**, C.Sanjeeviraja Inorganic Materials Recent Advances Eds. Dhirendra Bhadur, Satish Vitta and Om Prakash, Narosa Publishing House, New Delhi (2004) 215-217.
13	A novel economical electrochromic device based on the (VI-VI) well textured, transition metal oxide of WO_3 thin films prepared by PVD:EBE technique R.Sivakumar, **M.Jayachandran**, C.Sanjeeviraja Solid State Ionics: The science and technology of ionics in motion Ed.: B.V.R.Chowdari (2004) 737-744.
12	Electrochromic characterization of electrodeposited WO_3 thin films R.Vijayalakshmi, **M.Jayachandran,** C.Sanjeeviraja Proceedings of the 8th Asian Conference on Solid State Ionics: Trends in the new millennium (2002) pp 445-452.
11	Materials properties of $SnS_{0.5}Se_{0.5}$ thin films synthesized by brush plating B.Subramanian**,** C.Sanjeeviraja, S.Mohan, RM.Krishnan, **M.Jayachandran** Seventh International Symposium on Advances in Electrochemical Science and Technology (ISAEST – VII),1 (2002), D126-128.
10	Electrodeposition of $MoSe_2$ thin film and characterization T.Joseph Sahaya Anand , C. Sanjeeviraja, **M.Jayachandran** The 198th Meeting of The Electrochemical Society, Oct 22-27,Vol 2000-2 (2000) 1013
9	Preparation and characterization of spray pyrolysised SnS2 thin films L.Amalraj, C.Sanjeeviraja, **M.Jayachandran** The 198th Meeting of The Electrochemical Society, Oct 22-27,Vol 2000-2 (2000)1014
8	Characterization of semiconductor materials by fabrication of Schottky diodes and photoelectrochemical solar cells. **M.Jayachandrn**, K.R. Murali, T.Saravanan and V. Swaminathan Lecture Notes – Workshop on Materials and Charactrization, July 14-17, 1998, Karaikudi, pp.137-145.
7	Studies on cuprous oxide films for solar cell applications. T.Mahalingam, **M.Jayachandran**, C. Sanjeeviraja, S. Rajendran, J.S.P.Chitra Proc. DAE Solid Stte Physics Symp., 40C (1997) 175.
6	Electrochemical Synthesis of thick Cu_2O films. T.Mahalingam, C.Sanjeeviraja, S.Esther Dali, **M.Jayachandran**, M.J.Chockalingam The Electrochemical Society, Extended Abstracts (USA) 1996.
5	Physicochemical properties of screen-printed Cd_2SnO_4 semiconductor layers. **M.Jayachandran**, Mary Juliana Chockalingam and A.S. Lakshmanan The Electrochemical Society *(USA)* Extended Abstract 92 (1992) 694-695.
4	Thermal studies on Cd_2SnO_4 material useful for electrochromic and secondary battery devices. **M.Jayachandran**, Mary Juliana, V. Sundaram , A.S. Lakshmanan Solid State Ionics – Materials and Applications (1992) 629-633.
3	Materials properties of pulse plated $Cd_{1-x}Zn_xS$ films for $CuInSe_2$ based solar cells. **M.Jayachandran**, Mary Juliana Chockalingam, A.S. Lakshmanan 6th Inter. Photo. Scien. And Engg. Conf. (PVSEC-6) Proceeding (1992) 1045-1049.
2	X-ray and Scanning Electron Microscope Studies on Electrodeposited ZnCdS semiconductor alloys. **M.Jayachandran**, V. Vinni, T. Mahalingam, V.K.Venkatesan SPIE-Inter. Soc. Opt. Eng. (USA) 1284 (1990) 260-266.
1	Electrodeposition and characterisation of CdS thin film on transparent conducting SnO_2 substrates **M.Jayachandran**, Mary Juliana Chockalingam, N. Karuppiah Renewable Energy for Rural Development*,* Tata McGraw Hill, New Delhi (1989) 158-162.

ANNEXURE – IV

List of Honors/Awards/Fellowship/Editorship Received

1. 2013: Received Best Poster Award (Third Prize) 10^{th} International Symposium on Advances in Electrochemical Science and Technology (I SAEST 10) held at Chennai during 28-30 January 2013
2. 2012-2006: Directros' Nominee, Bureau of Indian Standards, Manak Bavan, New Delhi
3. 2011: Recevied paper award in the Eighth International Symposium on Applied Plasma Science, Hakkone, Japan during September 26-30, 2011.
4. 2010: Recevied 1 prize for both the oral and poster presentstion in the National conference on fifteenth national congress on corrosion control held at Chennai, 16-18, September 2010.
5. 2008: Directors' Nominee to attend workshop related to Solar Energy "EnTech Study Group" 22^{nd} November, CSIR, New Delhi.
6. 2009-2008: Member - Board of studies, Sri Nandhanam college of Engineering, Tiruppatur, Tamilnadu.
7. 2008 - 2006: Member - Board of studies, M.Sc (Post Graduate) Physics, Bishop Heber College, Trichy, Tamilnadu.
8. 2007: Sampath Award for contribution in Electrochemical Science & Technology, ECSI, I.I.Sc Campus, Bangalore
9. 2006 – 2005: Member - Board of studies, B.Tech. (Bachelor of Technology) School of Engineering and Technology, Bharathidasan University, Trichy, Tamilnadu.
10. 2006 – 2004: Member - Board of studies, M.Sc (Post Graduate) Materials Science & Technology, Thiagarajar College of Engineering, Madurai, Tamilnadu.
11. 2006 – 2004: Member - Board of studies, M.Sc (Post Graduate) Physics, Bishop Heber College, Trichy, Tamilnadu.
12. 2005: Director's representative, Brainstorming session on " Mainstreaming of Renewable Energy in the Country and Attaining Global leadership" , 16 – 17 June, Vigyan Bhawan, New Delhi.
13. 2005: Best Oral presentation award, Symposium on Non-linear optical crystals and modeling in Crystal Growth, Chennai, Tamilnadu.
14. 2002 - 2000: Member - Board of studies, M.Sc., Materials Science &Technology, Thiagarajar College of Engineering, Madurai, Tamilnadu.
15. 1987: Best Oral presentation award, National Symposium on Solar Energy held by Solar Energy Research Society of India (SESI), Madurai, Tamilnadu.
16. 1979-1976 CSIR Fellowship, Annamalai University, Annamalinagar, Tamilnadu
17. 1974: First prize - Top Student in Physics, Raja Duraisingam Memorial College, Sivagangai, Madurai (Kamaraj) University, Tamilnadu.

(a) International contributions: Editorship in Journals

Editor-in-Chief

18. Editor-in-Chief: Open Journal of Metals, Scientific Research Publishing Inc., **(January 2013- till date)**, International, Open Access Journal **(ISSN :2164-2761, ISSN:Online: 2164-277X)**

19. **Associate Editor**

    Associate Editor: Nanotechnology and Nanoscience, Bioinfo Publications, **(July 2013-till date)** International, Print/online **(ISSN: 0976-7630 Print, E-ISSN:0976-7649 online)**

Editorial Board Member

20. Editorial Member: Geomaterials, Scientific Research Publishing Inc., **(March 2011- till date)**, International, Open Access Journal **(ISSN :2161-7538, ISSN:Online: 2161-7546)**
21. Editorial Member: Open Journal of Metals, Scientific Research Publishing Inc., **(September 2011- December 2012)**, International, Open Access Journal **(ISSN :2164-2761, ISSN:Online: 2164-277X)**
21. Editorial Member: Journal of Powder Metallurgy & Mining, OMICS Publishing Group, **(November 2011- till date)**, International, Open Access Journal **(ISSN: 2168-9806)**

(b) National contributions

22. **Joint Editor:** Journal of Bulletin of Electrochemistry, CECRI In-house Journal, Karaikudi **(2001-03)**
23. **Editor:** Transaction of SAEST, Electrochemical Society (SAEST) Journal, Karaikudi **(2003-05)**
24. **Editor:** Current Titles in Electrochemistry, Electrochemical Society (SAEST) Journal, Karaikudi **(2003-05)**

(c) Office Bearer in Scientific Societies

25. **Vice-President**: Society for Advancement of Electrochemical Science & Technology SAEST), Karaikudi, India **(2011- 2013)**
26. **Governing Council:** Electrochemical Society of India, I.I.Sc., Bangaluru, India **(2007-08)**
27. **Secretary** : Society for Advancement of Electrochemical Science & Technology (SAEST), Karaikudi, India **(2003 - 05)**
28. **Joint Secretary*:*** Society for Advancement of Electrochemical Science & Technology (SAEST), Karaikudi, India **(2001-03)**

ANNEXURE – V

Natioanl /International events organized as Co-ordinator / Natioanal Organizing Committee Member

National Workshops organized

1. Principles and practice of Powder X-ray Diffraction (May 30- June 2005), **(Convenor)**
2. Thin film preparation and characterization techniques for energy conversion (14-17 November, 2004), **(Convenor)**
3. Income generation through solar energy utilization and corrosion prevention measurements (22 March 2003), **(Coordinator)**

International conference Organized

4. International conference on Electrochemical Power Systems (ICEPS -2) December 20-21, 2004, Hyderabad, India **(Organizing Secrtetary)**
5. Tenth International Symposium on Advances in Electrochemical Science and Technology (i SAEST 10), January 28-30,2013, India (National organizing Committee), **(Vice-President)**

National Conference Organized

6. Twelfth National Convention of Electrochemists (NCE -12), 18-19 February 2005, Madurai, India **(Organizing Secrtetary)**
7. Eleventh National Convention of Electrochemists (NCE -11) 26-27 December 2003, Tiruchirappalli, India **(Organizing Secrtetary)**
8. 17^{th} National Convention of Electrochemists (NCE -17) 14-15, September 2012 at BS.Abdur Rahman University, Chennai (Natioanl organizing Committee), **(Vice-President)**
9. 16^{th} National Convention of Electrochemists (NCE -16) 26-27 December 2011, Tiruchirappalli, India (organizing Secrtetary) at P.S.G.R Krishnammal College for Women, Coimbatore (Natioanl organizing Committee), **(Vice-President)**