Curriculum Vitae

Shyama Prasad Mohanty

Age – 35 Years (As on 01/08/2020)

Nationality-Indian

Marital Status-Single

Gender-Male

Category-General

Contact-

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Educational Details

Degree	Specialization	University/Board	Year	CPI/%
Ph.D.		Indian Institute of Technology Bombay	2015	9.63 (10)
M.Tech	Ceramic	National Institute of Technology Rourkela	2009	9.74 (10)
M.Sc.	Organic Chemistry	Ravenshaw University, Cuttack	2007	75.20%
B.Sc.	Chemistry	Ravenshaw College (Auto.), Cuttack	2005	73.55%
+2 Sc.	-	C.H.S.E., Odisha	2002	68.44%
10th	-	B.S.E., Odisha	2000	85.87%

Specialization

Materials Science, Ceramics, Chemistry

Research Interests

Synthesis of metal oxides, Processing of ceramics, Dye sensitized solar cells, Electrochemical energy devices, Polymeric films

Post Ph.D. Positions

Institute	Designation	Duration
CIPET:IPT, Bhubaneswar	Assistant Professor (Fixed Tenure)	March 2018-Till date
Indian Institute of Science, Bangalore	UGC-DSK Postdoctoral Fellow	April 2015-March 2018
Indian Institute of Technology Bombay	Temp. Project Research Scientist	Feb 2015-March 2015
Indian Institute of Technology Bombay	Research Associate	Aug 2014-Jan 2015

Work Experience In Major/Minor Academic Projects

Present Research Work (Guidance): Fabrication of Degradable Polymeric Films

Institute- Central Institute of Plastics Engineering and Technology: Institute of Plastics Technology (CIPET:IPT), Bhubaneswar, Odisha, India

Students Projects Guided: PG (M.Sc.-Polymer Science)-01 (Graduated), 01 (Ongoing)
UG (B.Tech-Plastics Engineering)-01

Brief Description-

The demand for plastics has increased significantly in the 21st century across the globe. However, due to the impact of such materials on the environment, there has also been parallel concern for recycling and biodegradation of plastics. Packaging is one among the several areas where polymers find their utility and biodegradable polymeric films are currently under investigation. Polyvinyl alcohol (PVA)/starch based polymeric films are mostly utilized in biodegradable films. To increase the compatibility of PVA with starch cross-linking agents are incorporated into the system. Citric acid (CA) has been utilized by various researchers as cross-linking agent. In the present research, boric acid (BA) has been explored as cross-linking agent to fabricate the films. Films of PVA/starch/BA have been prepared by using solution cast technique. Mechanical and optical properties of the films have been evaluated. Increase in the content of BA (1, 1.5 and 2 wt%) in films resulted in improvement in tensile strength whereas the percent elongation decreases. However, 5 wt% of BA in films resulted in poor film properties which was evident from turning of film into pieces while releasing from cast plate. Haze value of films increased upon increasing the BA content.

Post Doctoral Research Work- *Development of lithium-sulfur battery having high energy density and cycle stability.*

Mentor- Prof. N.Munichandraiah

Department- Department of Inorganic and Physical Chemistry, IISc Bangalore

Duration- April 2015 –March 2018

Brief Description-

Work on Li-S battery is ongoing postdoctoral research. Li-S batteries have the advantage of high energy density as compared to lithium ion batteries which makes them a suitable

candidate for energy storage. In such kind of batteries, energy density of 2500 Wh kg^{-1} can be achieved theoretically which is about 4-5 times higher that the value in lithium ion battery. Even though such technology has the potential to deliver up to the requirement but due to certain problems in such batteries, they have not been commercialized. Following problems are associated with Li-S batteries- poor conductivity of sulfur and its products, dissolution of polysulfides formed during discharge, formation of inactive layer or insulation layer on both Li and S electrodes, formation of lithium dendrite and their growth,. All of these lead to low cycle stability in such system even though such system has the advantage of low toxicity, low cost and it also uses materials which are abundantly available. Among all of the mentioned problems, dissolution of polysulfide species from cathode is a major problem which leads to capacity fading upon cycling. My research is focused on metal oxides to prevent dissolution of polysulfide species. Various porous structures of different metal oxides were synthesized. Sulfur was loaded into the pores by using solution of sulfur in carbon disulfide. The sulfur loaded metal oxides were used as active material for fabrication of batteries. It was observed that the porous structure trapped the polysulfides and retarded their dissolution which resulted in enhancement of capacity along with cycle stability.

Research Associateship Work- *Perovskite Sensitized Solar Cells*
Mentor- Prof. Parag Bhargava
Department- Department of Metallurgical Engineering and Materials Science, IIT Bombay
Duration- August 2014-January 2015

Brief Description-

Perovskites are well known to the scientific community which has a common formula of ABX_3 where A, B are cations and X is the anion. In perovskite based solar cells, the materials till now reported are organic-inorganic halides where A is the organic cation, B is the inorganic (mostly Pb) cation and X is the halide (I, Cl, Br) ion. Most widely studied material is methylammonium lead iodide ($CH_3NH_3PbI_3$). Advantages of perovskites are broad absorption spectrum, high hole mobility, high diffusion length, low non-radiative recombination rate and easy low temperature fabrication technique. Highest efficiency of 20.1% has been achieved in such kind of solar cell. This motivates researchers working across the glove on photovoltaics to focus on such kind of solar cells.

Normally, perovskite sensitized solar cells have a compact layer of titania, mesoporous titania layer coated with perovskite, hole transport layer and gold layer. During the tenure of research, work on

deposition of compact titania layer and on top of that mesoporous scaffold layer of titania or alumina by dip coating process was carried out. Titania sol was prepared by hydrolysis of titania precursor followed peptization process. Titania or alumina slurry for mesoporous layer was prepared by ball milling a mixture of nanopowder, binder and solvent. Different withdrawal rates were examined in order to obtain the desired thickness of ~100 nm for compact layer and 400 nm for mesoporous layer. After deposition of a layer, the film was heat treated at 450^{o}C/1h. Finally, perovskite ($CH_3NH_3PbI_3$) layer was deposited by spin coating process and then it was heat treated to evaporate the solvent followed by formation of desired phase. Then devices were made and tested for their photovoltaic characteristics.

Crystallization of perovskite ($CH_3NH_3PbI_3$) was carried out as a separate study. Different solvents based on their boiling point were used. After the deposition of perovskite layer on compact titania layer by spin coating, crystallization of perovskite was carried out under different solvent vapors. Variation in morphology was observed in recrystallized samples. Samples were also characterized by UV-visible spectroscopy and X-ray diffraction.

Ph.D. Thesis *Electrolytes for Dye Sensitized Solar Cells(DSSCs)*
Supervisor Prof. Parag Bhargava
Place Department of Metallurgical Engineering and Materials Science, IIT Bombay

Brief Description-

Dye sensitized solar cells (DSSCs) are low cost solar cells having ease of fabrication. Till now maximum light-to-electricity conversion efficiency of ~13% at full sunlight (100mW/cm^2) has been recorded in DSSCs. But improving the efficiency and stability of the cell is a key issue now-a-days. One of the factors which act as a barrier to such improvement is the electrolyte. Liquid electrolytes are used in most of the DSSCs and high efficiency has also been achieved. But liquid electrolytes are volatile and leakage is a problem. So, attempts have been made by researchers to replace the liquid electrolytes by quasi solid electrolytes or solid electrolytes. Work was focused on nanoparticulate loaded electrolyte and polymer membrane based electrolyte.

Nanopowders of silica/titania when loaded into liquid electrolyte form a gel and even in the gel state charge transport through the electrolyte is maintained due to ordered arrangement of anions (iodide/triiodide) on the surface of powders. Cations are adsorbed onto the surface of powders and anions (iodide/triiodide) are held to the cations. Adsorption of ionic species from electrolyte over nanopowder surface depends on the surface charge on nanopowders. So, it is

interesting to examine the effect of different isoelectric point based nanopowders, cations and solvents in nanoparticulate based quasi solid electrolyte on the performance of DSSCs. It was observed that high isoelectric point nanopowder (MgO) when added to liquid electrolyte drastically reduces the performance of DSSCs as compared to lower isoelectric point nanopowders (SiO_2, Al_2O_3) which achieve almost similar performance as liquid electrolyte. Adsorption of anions occurs on the surface of MgO as compared to cationic adsorption in SiO_2 or Al_2O_3 which was confirmed by zeta potential measurements. Such property of MgO led to reduction in recombination reaction at the titania/electrolyte interface as efficiently as 4-tert-butylpyridine (TBP) a well known recombination suppressant in DSSCs. Lithium ions based gel electrolyte was found to have significant enhancement in V_{OC} as compared to liquid electrolyte due to adsorption of lithium ions on silica surface which prevents their intercalation into or adsorption on titania. Among the different solvents examined, 3-methoxypropionitrile (MPN) was found to perform efficiently in both liquid and silica based gel electrolyte.

In addition to the nanoparticle loaded electrolytes, poly(vinylidenefluoride-co-hexafluoropropylene (PVDF-HFP) membrane based electrolytes were studied. Uniformly porous membrane was achieved when the membranes were cast at low temperature (28^{o}C). Increase in humidity resulted in increase in pore size in membranes whereas increase in temperature drastically decreased the porosity. Such features had direct influence on the performance of DSSCs where low temperature cast membranes based electrolyte performed as efficiently as liquid electrolyte.

Long term stability studies of liquid electrolyte and silica loaded electrolyte based cells have been carried out under short circuit conditions. It was observed that decrease in performance was more in silica loaded electrolyte based cells as compared to liquid electrolyte based cells under illumination while cells were maintained at 60^{o}C. In dark- room temperature condition, performance of both cells was almost stable. Apart from dissolution of platinum from counter electrode, desorption of additives and ions of electrolyte from bare surface of titania is responsible for such decrease in performance. Phase separation or aggregation of silica and deposition of silica on electrodes adds to the lowering of performance of silica loaded electrolyte based cells.

M.Tech Project Title *Processing of $BiFeO_3$ Ceramics by Gelcasting.*

Supervisor Prof. Sumit Kumar Pal

Place Department of Ceramic Engineering, N.I .T., Rourkela.

Brief Description-

Gelcasting is a near-net-shape forming method of advanced ceramic materials. It is used for making high-quality and complex-shaped ceramic parts. The process involves a slurry prepared from ceramic powder and a water based monomer solution which is poured into a mold, polymerized in-situ to immobilize the particles in a gelled part, removed from the mold while still wet, then dried and fired. Attempt to prepare $BiFeO_3$ ceramics by gelcasting was taken in the work. $BiFeO_3$ was synthesized by glycine-nitrate auto combustion route. The synthesized powder was calcined and phase purity was authenticated by XRD technique. Slurry was prepared using monomer and cross-linker premix solution. The slurry was cast and gelled. Finally, drying and sintering steps of the bodies were performed to obtain the final product.

Summer Project (May-July 2008)- High alumina and porcelain grog based castables.

Place-TATA Refractories Limited (Now known as TRL Krosaki Refractories Limited) Belpahar, Odisha.

Research Work Reported

Journals

International

1] "Dye Sensitized Solar Cells: A Review" A. Jena, S. P. Mohanty, P. Kumar, J. Naduvath, V. Gondane, P. Lekha, J. Das, H. K. Narula, S. Mallick and P. Bhargava, *Transactions of The Indian Ceramic Society* 71(1) (2012) 1-16

2] "Impact of isoelectric points of nanopowders in electrolytes on electrochemical characteristics of dye sensitized solar cells" S. P. Mohanty and P. Bhargava, *Journal of Power Sources* 218 (2012) 174-180

3] "Magnesia nanoparticles in liquid electrolyte for dye sensitized solar cells: An effective recombination suppressant?" S. P. Mohanty and P. Bhargava, *Electrochimica Acta* 90 (2013) 291-294

4] “Effect of sintering profiles on titania interparticle connectivity, electron transport and interfacial resistance in Dye-sensitized solar cells” A. K. Jena, S. P. Mohanty and P.Bhargava *Materials Science Forum* 771 (2014) 143-157

5] “Influence of iodide source on the performance of liquid and silica nanoparticle-loaded quasi-solid electrolyte-based dye-sensitized solar cells” S. P. Mohanty and P. Bhargava, *Ionics* 21 (2015) 849-854

6] “Effect of aging conditions on the performance of dip coated platinum counter electrode based dye sensitized solar cells” S. P. Mohanty, V.More and P. Bhargava, *RSC Advances* 5 (2015) 18647-18654

7] “Impact of electrolytes based on different solvents on the long term stability of dye sensitized solar cells” S. P. Mohanty and P. Bhargava, *Electrochimica Acta* 168 (2015) 111-115

8] “A simple route to making counter electrode for dye sensitized solar cells (DSSCs) using sucrose as carbon precursor” R. Kumar, V. More, S. P. Mohanty, S. S. Nemala, S. Mallick and P. Bhargava*, Journal of Colloid and Interface Science* 459 (2015) 146-150

9] “Effect of casting condition on the porosity of polymer membrane and its impact on the photoelectrochemical behavior of dye-sensitized solar cells” S. P. Mohanty and P. Bhargava, *Ionics* 22 (2016) 1217–1223

10] “Investigation of in situ grown and carbon-free copper sulfide electrode for rechargeable lithium battery” S. P. Mohanty and N. Munichandraiah, *Journal of Electroanalytical Chemistry* 794 (2017) 8-14

11] “Composites of Sulfur-Titania Nanotubes Prepared by a Facile Solution Infiltration Route as Cathode Material in Lithium-Sulfur Battery” S. P. Mohanty, B. Kishore and N. Munichandraiah, *Journal of Nanoscience and Nanotechnology* 18 (2018) 6830-6837

12] “The Effect of Surface Modification of TiO_2 on the Electrochemical Performance of Lithium-Sulfur Cell” S. P. Mohanty and N. Munichandraiah, *Bulletin of Materials Science* 41 (2018) Article 136

13] “Influence of solvent on the performance of liquid and silica nanoparticle loaded quasi solid electrolyte based dye sensitized solar cells” S. P. Mohanty and P. Bhargava, *Materials Technology: Advanced Performance Materials* (2020) doi:10.1080/10667857.2020.1786787

14] “Characteristics of Ionic Adsorption on Silica Nanoparticles and its Impact on the Long Term Stability of Dye Sensitized Solar Cells” S. P. Mohanty and P. Bhargava, *Bulletin of Materials Science* (2020) Accepted

Conferences/Symposiums

International

1] “Influence of nanoparticulates loaded liquid electrolyte on the performance of dye sensitized solar cells” S. P. Mohanty, A. K. Jena, P. Kumar and P. Bhargava, International Conference on TAP SUN: The Sustainable Future" (ICTAP SUN-2011) at IICT, Hyderabad, 25th -26th November, 2011

2] “Nanoparticulate loaded quasi solid electrolytes for dye sensitized solar cells (DSSCs)” S. P. Mohanty, A. K. Jena, P. Kumar and P. Bhargava, International Conference on Advances in Energy Research (ICAER-2011) at IIT Bombay, 09th – 11th December 2011

3] “Effect of different aging conditions on the performance of dye sensitized solar cells” A. Tembhekar, S. P. Mohanty and P. Bhargava, International Conference on Advances in Energy Research (ICAER-2013) at IIT Bombay, 10th – 12th December 2013

4] “Encapsulation of sulfur in titania nanotubes and its impact on performance of lithium-sulfur battery” S. P. Mohanty and N. Munichandraiah, International Conference of Young Researchers on Advanced Materials (IUMRS-ICYRAM 2016) at IISc Bangalore, 11th – 15th December 2016

5] “In situ Grown Copper Sulfide: An Approach towards Conducting Carbon Free Electrode for Rechargeable Lithium Battery” S. P. Mohanty and N. Munichandraiah, Second International Conference on Electrochemical Science and Technology (ICONEST – 2017) at IISc Bangalore, 10th – 12th August 2017

National

1] “Effect of nanoparticulate addition to liquid electrolytes on the performance of dye sensitized solar cells (DSSCs)” S. P. Mohanty, A. K. Jena, P. Kumar and P. Bhargava, 4th National Symposium for Materials Research Scholars-MR-12 at IIT Bombay, 03rd – 05th May 2012

2] "Role of isoelectric point of oxide nanopowders loaded into liquid electrolytes in determining electrochemical characteristics of dye sensitized solar cells" S.P.Mohanty and P.Bhargava, National symposium on materials and processing-2012 (MAP-2012) at BARC, Mumbai, 10^{th} – 12^{th} October 2012

Book Chapter

1] "Electrochemistry of Rechargeable Batteries Beyond Lithium-Based Systems" B. Kishore, S. P. Mohanty and N. Munichandraiah, Chapter-1 in "Nanomaterials for Electrochemical Energy Storage Devices" P. Roy and S. K. Srivastava (Editors) Scrivener Publishing, Wiley (2019) Page-1-66

Referees

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