

M.B. Sahana, Ph.D.

Sr. Scientist

Centre for Automotive Energy Materials (CAEM)

International Advanced Research Centre for

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PROFESSIONAL EXPERIENCE

Sr. Scientist

July 2012 – current

International Advanced Research Centre for

Powder Metallurgy and New Materials (ARCI)

IITM Research Park, Chennai, India

- ❖ Designing and implementing research protocols and projects; applying advanced analytical techniques and practices in innovative research projects in the field of Lithium-ion batteries for electric vehicles and hybrid electric vehicles (LIB for EV and HEV)
- ❖ Applying diversified knowledge of scientific research principles, practices, and protocols in research projects; makes recommendations and conclusions that serve as the basis for decision-making in road maps of next-generation lithium-ion and solid-state batteries.
- ❖ Collaborating with scientists within ARCI and outside on design, analysis, application, and reporting of research projects
- ❖ Supervising Ph.D. students, Jr. Scientists, technicians, B. tech, M. tech and MSc students.

- ❖ Prepare, analyse, report, and other documentation for publication; present findings at local, national, and/or international meetings.
- ❖ Prepares grant proposals to obtain funding in support of research activities.

Postdoctoral fellow

Jan. 2006 – May 2010

Wayne State University, Detroit, MI, USA

- ❖ Lithium ion batteries
- ❖ Developed nanostructured electrode materials such as LiFePO_4 , $\text{Fe}_2(\text{SO}_4)_3$, V_2O_5 for lithium ion battery applications
- ❖ Band Gap Engineering by Tuning Particle Size and Crystallinity of Nanocrystalline Composite Thin Films.
- ❖ Engineering nanostructured transition metal oxide thin films for gas sensing applications and dye sensitized solar cells.
- ❖ Fabrication of nanotubes of CoFe_2O_4 by sol-gel electrophoresis, template assisted method
- ❖ Raman Spectroscopy and Electron microscopy on Wag31 Proteins in Mycobacterium tuberculosis: A Physics / Biology Interdisciplinary Project at WSU
- ❖ Surface enhanced Raman spectroscopy (SERS) to increase the sensitivity of Raman signal from bacteria.
- ❖ Taught three credit general physics courses for undergraduate physics students.

Postdoctoral Fellow

Jan 2005- Aug. 2005

Stockholm University, Stockholm, Sweden

- ❖ *Guiding of highly charged ions by highly ordered SiO_2 nanocapillaries* fabricated by photo assisted electrochemical etching.

Research Scholar

August 1998 – April 2004

Material Research Centre, Indian Institute of Science, Bangalore, India

- ❖ Thin film growth by Metalorganic Chemical vapour deposition (MOCVD) precursor
 - ❖ Vanadium oxide thin films for smart windows
 - ❖ A three orders of magnitude jump in the resistivity at semiconductor to metal transition by VO₂ films on glass substrates is achieved by tuning the microstructure by MOCVD
 - ❖ structure property correlation of temperature dependent metal insulator transition of various vanadium oxides
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EDUCATION

Ph.D (Materials Science)

Materials Research Centre,

April 2004

Indian Institute of Science, Bangalore, India,

(Supervisor: Prof. S.A. Shivashankar)

Thesis Title: ***Metalorganic Chemical Vapour Deposition of Thin Films of Vanadium Oxides: Microstructure and Properties***

M.Sc (Physics)

1995-1997

Mangalore University, Karnataka, India

B.Sc (Physics, Chemistry, mathematics)

1992-1995

S.D.M. College Ujire, angalore University, India

Funded Project

1. High voltage carbon encapsulated-graded LiMn₂O₄:LiNi_{1-x-y}Co_xAl_yO₂ cathodes for rechargeable Li-ion pouch cells, DST, 2018- 2021 : PI
2. Recycling of Polymer Electrolyte Membrane from Fuel Cell for use as Electrolyte in All-Solid-State Lithium Battery funded by SERB-Core grant 2021- 24: Co-PI
3. "Investigation and Development of All-Phosphate Dual-Ion Solid-State Batteries" India Russia: International Cooperation Division 2022-2025 Co-PI

PhD Supervised

1. “Structure and electrochemical property correlation of nano micro hierarchical structured $\text{LiNi}_{1-x-y}\text{Co}_x\text{Al}_y\text{O}_2$ ” N. Sasikala Department of Metallurgical and Materials Engineering, IIT Madras **2021**
2. Enhancement of cycle life of li-ion battery by in-situ carbon encapsulation on layered oxide based cathode materials S. Vasu, Department of Metallurgical and Materials Engineering, IIT Madras **2021**
3. Layered oxide cathode materials and electrodes in lithium-ion batteries for electric vehicle applications: A process- structure-property correlation, Mahender Peddi, Department of Metallurgical and Materials Engineering, IIT Madras **2023**

Know How transfer and training:

Lithium-ion battery pouch cell fabrication: Receiving company Q Pi Volta, Bangalore

Academic projects guided/ongoing:

1. Optimization of composition of the anode for lithium ion batteries” Sreethika K.H M.Sc Physics 2018
2. Synthesis of Oxide-based Solid Electrolyte Li_4SiO_4 , $\text{Li}_{4-x}\text{Si}_{1-x}\text{Al}_x\text{O}_4$ and $\text{Li}_{4-x}\text{Si}_{1-x}\text{P}_x\text{O}_4$ Rajanarayanan M.Tech Nano science and Technology 2019
3. Investigation into the fabrication of Hybrid solid electrolyte for lithium ion battery G Ebenezer Prasanna , Integrated MSc. 2019
4. Optimization of electrode coating for $\text{LiNi}_{1-x-y}\text{Co}_x\text{Al}_y\text{O}_2$ pouch cell fabrication Rany Selvam S B Tech in ceramic technology, 2018
5. Effect of particle size and composition on electrochemical performance of graphite anodes, Parvathavarthini A and Sandhiya . N M.Sc. Physics 2018
6. Optimization of pH during co-precipitation of $\text{LiNi}_{1-x-y}\text{Co}_x\text{Al}_y(\text{OH})_2$ layered double hydroxide synthesis; precursor for $\text{LiNi}_{1-x-y}\text{Co}_x\text{Al}_y\text{O}_2$, Lincy A M. Tech 2017
7. Synthesis and Investigation on Li-rich cathode materials for enhanced Li-ion batteries performance national Post Doctoral Fellow (SERB-DST) 2017
8. Investigation of Influence of rheology of electrode slurry on electrochemical properties of LIB, K. Kumari, Ongoing PhD registered at IIT Bombay

9. Layered oxide cathode materials and electrode in lithium-ion batteries for electric vehicle applications: Process-structure - property correlation. Mahender Pedi, Ongoing Ph D Registered at IIT Madras.

Book Chapter:

Recent Developments in Electrode Materials for Lithium-Ion Batteries for Energy Storage Application in the 'Handbook of Advanced Ceramics and Composites' **M. B. Sahana*** and R. Gopalan, Springer publication, 2019

Patent Granted

A Process for In-Situ Carbon Coating on Alkali Transition Metal Oxides" patent no. **416052** M. B. Sahana, S. Vasu, Sathya mariappan, and R. Gopalan

List of publications

(* = corresponding Author and project lead)

1. Capacity degradation of lithium-ion cell: The role of free carbon black content in the slurry and drying induced cracks in LiFePO_4 electrode, Kumari Konda, Megha Sara Jacob , Jyoti R. Seth, Vinay A. Juvekar, Raghavan Gopalan, Sahana B. Moodakare*, *Journal of Energy Storage* 74 (2023) 109477
2. Multi-Layer Graphene as Cathode Conductive Additive in Lithium-ion Pouch Cells: A Correlation of Changes in Electrolyte Uptake and Composition of Electrode Electrolyte Interface to Enhanced Cyclic Stability, Mahender Peddi, **Sahana M. B***, Akshay Kumar Budumuru, Kamaraj Muthusamy, Govindan Sundararajan, Raghavan Gopalan, *ACS Appl. Energy Mater.* 2023, 6, 6, 3251–3263
3. Standardization of ionic conductivity measurements in $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ -polymer composite electrolytes, Megha Sara Jacob, Nikhil Doddi, Vasu Shanmugam, Gopikrishnan Ebenezer Prasanna, Mahender Peddi, Raman Vedarajan, **M. B. Sahana***, Raghavan Gopalan, *Materials Science and Engineering: B*, 2022, 286, 116049
4. Effects of Nano-Micro Hierarchical Architecture Intraparticle Connectivity and Carbon Black-LiNi_{1/3}Mn_{1/3}Co_{1/3}O₂ Interaction: An Energy-Power Tradeoff In Lithium-Ion Batteries, Mahender Peddi, **M. B. Sahana*** M Kamaraj, G Sundararajan, Gopalan Raghavan *Journal of The Electrochemical Society*, 169, 020576

5. Surface oxygen vacancy engineering and physical protection by **in-situ** carbon coating process of lithium rich layered oxide Vasu Shanmugam, Sasikala Natarajan, Laurel Simon Lobo, Ankita Mathur, **M. B. Sahana***, G. Sundararajan, and R. Gopalan *Journal of power sources*, 515 (2021) 230623
6. Comprehensive effort on electrode slurry preparation for better electrochemical performance of LiFePO₄ battery Kumari Konda, **M. B. Sahana***, P. Logesh Kumar, Manjusha Battabyal, Jyoti R. Seth, Vinay A. Juvekar, Raghavan Gopalan, *Journal of power sources*, 480 (2020) 228837
7. Concentration Gradient-Driven Aluminum Diffusion in a Single-Step Coprecipitation of a Compositionally Graded Precursor for LiNi_{0.8}Co_{0.135}Al_{0.065}O₂ with Mitigated Irreversibility of H₂ ↔ H₃ Phase Transition, Sasikala Natarajan, **M. B. Sahana***, Prathap Haridoss and Raghavan Gopalan, *ACS Appl. Mater. Interfaces* 2020, 12, 31, 34959–34970
8. Infrared Spectroscopy Signatures of Aluminum Segregation and Partial Oxygen Substitution by Sulfur in LiNi_{0.8}Co_{0.15}Al_{0.05}O₂ N. Sasiakala, **M. B. Sahana***, S. Vasu, P. Haridoss, and R. Gopalan, *ACS Appl. Energy Mater.*, 2018, 1 (6), pp 2536–2545
9. High temperature magnetic studies on Bi_{1-x}Ca_xFe_{1-y}Ti_yO_{3-δ} nanoparticles: Observation of Hopkinson-like effect above T_N, PSV Mocherla, D Prabhu, **M. B Sahana**, NY Hebalkar, R Gopalan, MS Ramachandra Rao, C Sudakar, *Journal of Applied Physics* 124 (7), 073904
10. In-situ carbon encapsulation of LiNi_{1/3}Co_{1/3}Mn_{1/3}O₂ using pillared ethylene glycol trapped in the metal hydroxide interlayers for enhanced cyclic stability S Vasu, **M. B. Sahana***, C Sudakar, R Gopalan, G Sundararajan *Electrochimica Acta* 251, 363-377
11. Microstrain engineered magnetic properties in Bi_{1-x}Ca_xFe_{1-y}Ti_yO_{3-δ} nanoparticles: deviation from Néel's 1/d size-dependent magnetization behaviour, Pavana S. V Mocherla, **M. B Sahana**, R. Gopalan, M.S Ramachandra Rao, B. R. K Nanda, C. Sudakar, *Materials Research Express* 4 (10), 106106, 2017
12. Raman spectral signature of Mn-rich nanoscale phase segregations in carbon free LiFe_{1-x}Mn_xPO₄ prepared by hydrothermal technique, **M. B. Sahana***, S. Vasu, N. Sasikala, S. Anandan, H. Sepehri-Amin, C. Sudakar and R. Gopalana, *RSC Adv.*, 4, 2014, 64429.
13. Quantum confinement effects and band gap engineering of SnO₂ nanocrystals in a MgO matrix, M.B. Sahana, C. Sudakar, A. Dixit, J.S. Thakur, R. Naik, V.M. Naik, *Acta Materialia*, 60(3) 2012, 1072-1078.

14. Nanostructured high specific capacity C-LiFePO₄ cathode material for lithium-ion batteries, K. Bazzi, K.S Dhindsa, A. Dixit, **M. B. Sahana**, C. Sudakar, M. Nazri, ZX.Zhou, P. Vaishnava, V.M Naik, G.A. Nazri, R. Naik, *J. Mater. Res.* (2012), 424-430.
15. Regulation of Polar Peptidoglycan Biosynthesis by Wag31 Phosphorylation in Mycobacteria, C. Jani, H. Eoh, JJ Lee, K Hamasha, **M.B. Sahana**, J.S. Han, S. Nyayapathy, J.Y. Lee, J.W Suh, S.H. Lee, S.J Rehse, D.C. Crick, C.M. Kang, *BMC Microbiology* 10 Art No. 327, (2010).
16. The effect of Wag31 phosphorylation on the cells and the cell envelope fraction of wild-type and conditional mutants of Mycobacterium smegmatis studied by visible-wavelength Raman spectroscopy, K. Hamasha, **M. B. Sahana***, C. Jani, S. Nyayapathy, C.M Kang, and S. J. Rehse. *Biochemical and Biophysical Research communications*, (2010) 391, 664-668.
17. Coexistence of anion and cation vacancy defects in vacuum-annealed In₂O₃ thin films, C. Sudakar, A. Dixit, Sanjiv Kumar, **M. B. Sahana**, G. Lawes, R. Naik and V.M. Naik, *Scripta Materialia* 62(2), 63 (2010).
18. The effect of titanium on the lithium intercalation capacity of V₂O₅ thin films' **M. B. Sahana***, C. Sudakar, C. Thapa, V.M. Naik, G.W. Auner, R. Naik and K.R. Padmanabhan 'Thin Solid Films, (2009), 24, 6642-6651.
19. Structural, magnetic, and electrical studies on polycrystalline transition metal doped BiFeO₃ thin films", P. Kharel, S. Talebi, B. Ramachandran, A. Dixit, V.M. Naik, M. B. Sahana, C. Sudakar, R. Naik, M.S.R. Rao, G. Lawes, *J. Phys. Cond. Matter.* (2009) 21 036001.
20. Band Gap Engineering by Tuning Particle Size and Crystallinity of SnO₂-Fe₂O₃ Nanocrystalline Composite Thin Films, M. B. Sahana, C. Sudakar, G. Setzler, A. Dixit, J.S. Thakur, G. Lawes, R. Naik, V.M. Naik, and P.P. Vaishnava, *Applied Physics Letters*, (2008), 93(23), 231909/1-231909/3.
21. Guiding Of Highly-Charged Ions Through Insulating Nano-Capillaries, R. Schuch, M. B. Sahana, I. L. Soroka, Gy.Vikor, R. T. Kumar, Z. Hongqiang, A. Johansson and P. Skog, *Canadian journal of physics*, (2008), 86, 327-330.
22. Influence of the stoichiometry of V₂O₅ thin films on electrochemical properties, **M. B. Sahana***, C. Sudakar, G. Lawes, V.M. Naik, Ron Baird, G.W. Auner, K. R. Padmanabhan, and R. Naik, *Materials Science and Engineering B*, (2007), 143 42-50.

- 23.** Ion implantation and ion beam analysis of MOD deposited oxide films,
X. Marko, P. Talagala, M. B. Sahana, R. Naik, K.R. Padmanabhan, C. P. Marques, E. Alves, Nuclear Instruments & Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms , (2007), 261, 456-460.
- 24.** Guiding of highly charged ions by highly ordered SiO₂ nanocapillaries. **M. B. Sahana***, P. Skog, Gy. Viktor, R. T. Rajendra Kumar, R. Schuch, Physical Review A: Atomic, Molecular, and Optical Physics , (2006), 73, 040901/1-040901/4.
- 25.** Metalorganic chemical vapor deposition of highly oriented thin film composites of V₂O₅ and V₆O₁₃: Suppression of the metal-semiconductor transition in V₆O₁₃, M.B. Sahana, S. A. Shivashankar, Journal of Materials Research, (2004), 19, 2859-2870.
- 26.** Growth of nanowires of β -Na_xV₂O₅ by metalorganic chemical vapor deposition M.B. Sahana, S. A. Shivashankar, Journal of Materials Chemistry, (2003), 13, 2254-2260.
- 27.** Phase transformation and semiconductor-metal transition in thin films of VO₂ deposited by low-pressure metalorganic chemical vapor deposition, M. B. Sahana, G. N Subbanna, S.A Shivashankar, Journal of Applied Physics, 92, (2002),6495-6504.
- 28.** Microstructure and properties of VO₂ thin films deposited by MOCVD from vanadyl acetylacetonate M. B. Sahana, M.S. Dharmaprakash, S.A. Shivashankar, Journal of Materials Chemistry, (2002), 12, 333-338.
- 29.** Room temperature ferromagnetism in Cr-doped In₂O₃ on high vacuum annealing of thin films and bulk sample, P. Kharel, C. Sudakar, M.B. Sahana, G. Lawes, R. Suryanarayanan, R.Naik, V. M. Naik, Journal of Applied Physics (2007), 101, 09H117.
- 30.** ‘Time evolution of the microstructure of VO₂(B) films deposited on glass by MOCVD’, M. B. Sahana, G. N. Subbanna, and S. A. Shivashankar, Mater. Research society symposium proceedings, vol. 749, 2003, W.5.14,
- 31.** ‘Transmission of slow Ne⁷⁺ ions through nanocapillaries’ M. B. Sahana, P. Skog, Gy. Viktor, R.T. Rajendra kumar, and R. Schuch, Book of Inv. Papers, Intern. Conf. on Photonic, Electronic, and Atomic Collisions,