

Dr. Digamber G. Porob

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SUMMARY:

Materials scientist with 13+ years' experience in solid state chemistry and materials development. Worked with global teams and led interdisciplinary projects in developing new materials and processing technologies for GE businesses. Demonstrated expertise in developing new materials and processes in oxide, nitride, halide, oxynitride and oxyhalide systems with applications in phosphors, ionic conductors, magnetocaloric, multiferroic, photocatalytic and thermal barrier coatings. Secured Twenty international patents/applications and published nine papers in peer reviewed journals. Trained in Six Sigma methodology (Green belt), Foundations of leadership (GE), Building essential leadership skills and Innovative problem-solving tools. 3 years of teaching experience in Chemistry for UG and PG students.

TECHNICAL EXPERTIZE:

- Developed new patented phosphor materials from oxides, oxynitrides, nitrides and halides for applications in phosphor converted white LED applications (LED Bulbs).
 - Developed new process for phosphor manufacturing in Fluorescent lighting and transitioned the technology to business.
 - Developed inorganic compositions for next generation thermal barrier coating (TBC) technologies for GE jet engines and CMAS cleaning processes for combustor liners.
 - Profound expertise in Crystal structure determination and refinement from powder (Rietveld) and single crystal X-ray diffraction techniques.
 - Experience in leading and working with global teams for technology development and transfer.
 - Scale up of new research processes for phosphor production from lab scale to real-time large-scale manufacturing.
 - Provided chemistry and crystallography support for wide spectrum of materials research groups such as luminescent materials, corrosion, coatings and ceramic processing.
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LEADERSHIP EXPERTIZE:

- Project management and technical leadership. Led projects on phosphor development, metal recovery, coal beneficiation and combustor liner cleaning.
 - Trained the shop floor team for new materials processing methods during technology transfer of new phosphor manufacturing process.
 - Lab representative for GE's Environment, Health and Safety committee and Radiation safety committee.
 - Trained in GE Foundations of leadership, Building essential leadership skills and Innovative problem solving tools.
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EXPERIENCE:

Associate Professor (Analytical Chemistry) – School of Chemical Sciences (June 2020 – till date) at Goa University, Taleigao, Goa 403206

Assistant Professor – Department of Chemistry (June 2017 – June 2020) at DCT's Dhempe College of Arts and Science, Miramar, Panaji, Goa 403001.

Taught Inorganic Chemistry for SY and TY BSc. Conducted Practicals in Inorganic, Analytical and Organic Chemistry for FY/SY/TY BSc students

Taught Inorganic Chemistry for M.Sc. Part I, Analytical Chemistry students

Materials Scientist (August 2006 – March 2020) at Materials and Manufacturing, GE (JFWTC), Bangalore, India

Discovered new inorganic luminescent materials for GE businesses for next generation lighting products; in particular phosphor converted white LED and fluorescent lighting.

Developed innovative processes for recovery of rare earth elements from phosphor lamp waste. Discovered new low-cost luminescent material manufacturing process during rare earth material crisis of 2009-2012. Led the global team in transitioning this technology for manufacturing at large scale to GE Lighting.

Worked on development of new materials and processes for magnetic refrigeration, scintillators, CIGS solar cell, coal beneficiation and thermal barrier coatings.

Evaluated performance of GE Metal Halide battery components under corrosive environment at high temperatures by developing testing mechanism and analysis protocol.

Secured Twenty international patents/applications and published fourteen research articles in international journals. Participated in National and International conferences with poster and oral presentations.

Senior Research Fellow (August 2004 – June 2006) – Department of Chemistry, NCSU – North Carolina, USA

Synthesis and structural investigations of multiferroic materials: Investigated multiferroic materials exhibiting simultaneous semiconducting, ferroelectric, and ferromagnetic

properties in $\text{Bi}_4\text{Ti}_3\text{O}_{12}\cdot\text{AMO}_3$ (where A = Bi, La; M = Cr, Mn, Fe, Co or Ni) systems. These materials were synthesized using hydrothermal, molten salt and/or solid-state methods and were evaluated for their magnetic properties. The detailed structural analysis was done using powder X-ray and neutron diffraction data.

Photocatalytic generation of hydrogen for clean energy: Studied the photocatalytic water splitting properties of various metal tantalates and titanates with different crystal structure systems and particle sizes in order to generate H_2 and O_2 in both UV and visible range. Published three research papers in international journals based on this work.

EDUCATIONAL QUALIFICATIONS:

Ph. D, Solid State Chemistry, Indian Institute of Science, Bangalore - India (June 2004)

Thesis title: Synthesis and Structural Investigation of Novel Ionic Conductors in $M_x\text{Bi}_3\text{V}_2\text{O}_{10}$ System [M=Li, Na, Ag (x=1); Ca, Sr (x=0.5)] (With Professor T. N. Guru Row)

Synthesis of new materials with novel structural types in $M_x\text{Bi}_3\text{V}_2\text{O}_{10}$ system exhibiting ionic conductivity was the main objective of the thesis. Different compositions with M=Li, Na, Ag (x=1); Ca, Sr (x=0.5) were synthesized and studied for ionic conductivity as well as their structures determined using powder X-ray and neutron diffraction methods. This research work provided new class of ionic conductors with novel structural types. Published four research articles in international journals and participated in National and International conferences with poster and oral presentations.

M.Sc. (Inorganic Chemistry) Goa University, Goa – India (July 1998)

AWARDS/RECOGNITIONS

- GE Gold medal for filing 20 patent applications – 2017.
- Phosphor award 2016 by Phosphor research society, The electrochemical society of Japan (Team award).
- GE Manufacturing & Materials 2015 Award for LED Red Phosphor (Team Award)
- GE-GRC-Bangalore "2011 Technical Quality Award" in the "Scientific Discovery" category
- X Indian Council of Chemists Conference Endowment award for securing first rank in the subject of Inorganic Chemistry at the M.Sc.
- Best poster award at the XXXII National Seminar on Crystallography (NSC-2002) October 24-26, 2002, Jammu, India.
- Fellowship from Council of Scientific and Industrial Research (CSIR), Government of India (1998 – 2003)
- Published nine papers in peer reviewed journals and secured thirteen international patents.

Dr. Digamber G. Porob - Research Publications and Patents:

(A) Papers in refereed journals

1. A Novel Oxide Ion Conductor in a Doped $\text{Bi}_2\text{O}_3\text{-V}_2\text{O}_5$ System: *Ab Initio* Structure of a New Polymorph of $\text{NaBi}_3\text{V}_2\text{O}_{10}$ via Powder X-ray Diffraction, **Digamber G. Porob** and T. N. Guru Row, *Chem. Mater.* **2000 (12)** 3658.
2. *Ab initio* Structure Determination via Powder X-Ray Diffraction, **Digamber G. Porob** and T. N. Guru Row, *Proc. Indian Acad. Sci. (Chem. Sci.)* **2001 (113)** 435.
3. Synthesis and Crystal Structure of $\text{M}_{0.5}\text{Bi}_3\text{P}_2\text{O}_{10}$ (M=Ca, Sr, Ba, Pb) Series, **Digamber G. Porob** and T. N. Guru Row, *Acta Cryst.* **2003 (B59)** 606.
4. Synthesis, Crystal Structure and Oxide Ion Conductivity in $\text{Ca}_{0.5}\text{Bi}_3\text{V}_2\text{O}_{10}$ and $\text{Sr}_{0.5}\text{Bi}_3\text{V}_2\text{O}_{10}$, **Digamber G. Porob** and T. N. Guru Row, *J. of Solid State Chem.*, **2004 177(12)** 4535.
5. Synthesis of Textured $\text{Bi}_5\text{Ti}_3\text{FeO}_{15}$ and $\text{LaBi}_4\text{Ti}_3\text{FeO}_{15}$ Layered Aurivillius Phases by Molten Salt Flux Method, **Digamber G. Porob** and Paul A. Maggard, *Mat. Res. Bull.* **2006 (41)** 1513.
6. Flux Synthesis of La-doped NaTaO_3 and Its Photocatalytic Activity, **Digamber G. Porob** and Paul A. Maggard, *J. of Solid St. Chem.* **2006 (179)** 1726.
7. A Rapid Flux-Assisted Synthetic Approach Towards the Bandgap Engineering of Layered Perovskites, **Digamber G. Porob** and Paul A. Maggard, *Chem. Mater.* **2007 (19)** 970.
8. Concentration Quenching in Ce^{3+} doped LED Phosphors, A A Setlur, **D G Porob**, U Happek and M G Brik, *Journal of Luminescence* 2012 **(133)** 66–68
9. Inhomogenous Broadening, Charge Compensation, and Luminescence Quenching in Ce^{3+} -Doped $\text{Sr}_3\text{AlO}_4\text{F}$ Phosphors, A. A. Setlura, **D. G. Porob**, U. Happek and M. G. Brik, *ECS Journal of Solid-State Science and Technology*, 5 (1) R3089-R3095 (2016)

(B) Papers in conference proceedings

10. Preparation and Luminescence of $\text{BaSi}_6\text{N}_8\text{O: Eu}^{2+}$ Oxynitride Phosphor, Nagaveni Karkada, **Digamber Porob**, Nammalwar K Prasanth, Anant Setlur, *ECS Trans.* **2009 16(31)** 41-50
11. Eu^{2+} Doped Calcium Chlorosilicate Phosphors: Polymorphism and Luminescence Properties, Nagaveni Karkada, **Digamber G. Porob**, Prasanth Kumar and Anant Setlur, *ECS Trans.* **2011 33(33)** 39-47
12. Synthesis and Luminescence Properties of Green Oxynitride Phosphor, **Digamber G Porob**, Satya Kishore Manepalli, Nammalwar Prasanth Kumar, Anant Setlur, *ECS Trans.* **2011 33(33)** 101-107
13. Structure and Photoluminescence of Eu^{2+} Activated $\text{SrScSi}_4 (\text{O,N})_7$ Green Phosphors, **Digamber Porob**, Nagaveni Karkada, Nammalwar Prasanth Kumar, Anant Setlur, *ECS Trans.* **2012 41(37)** 27-38

14. Synthesis and Luminescence of Eu²⁺ Activated Yellow Oxynitride Phosphor, Prasanth Kumar Nammalwar, Manepalli Satya Kishore, **Digamber Porob**, A.A Setlur, and F. Garcia Santamaria, ECS Trans. **2013** volume 50, issue 42, 17-25

(C) Papers presented in conferences but not published

1. **Oral presentation** entitled “*Ab initio* X-ray Powder Diffraction Studies of Polymorphism in Na₂O-Bi₂O₃-V₂O₅ Ternary System” **Digamber G Porob** and T N Guru Row at the Asian Crystallographic Association (AsCA'01) November 18-21, 2001, Indian Institute of Science, Bangalore, India.
2. **Poster presentation** entitled “*Ab initio* Structure Determination of LiBi₃V₂O₁₀ by Powder X-ray Diffraction” **Digamber G Porob** and T N Guru Row at the XIX Congress and General Assembly of the International Union of Crystallography, August 6-15, 2002, Geneva, Switzerland.
3. **Poster presentation** entitled “Synthesis and Structural Investigation of MBi₃V₂O₁₀ (M=Li, Na, Ag) System by Powder X-Ray and Neutron Diffraction” **Digamber G. Porob** and T N Guru Row at the XXXIII National seminar on Crystallography (NSC-2004) January 8-10, 2004, Pune, India.
4. **Poster presentation** entitled “Synthesis and Characterization of Bi₄Ti₃O₁₂.AM₂O₃ (A = Bi, La; M = Cr, Mn, Fe, Co, Ni) series of compounds” **Digamber G. Porob** and Paul A. Muggard at the Midwest Solid-State Chemistry Conference 2005 May 26-28, 2005, Notre Dame, Indiana USA.
5. **Oral presentation** entitled “Luminescence and Energy Transfer Mechanism in Ca₂Si₅N₈:Ce³⁺, Eu²⁺” M. Satya Kishore, **Digamber Porob**, N. Prasanth Kumar, Robert Lyons and Anant A. Setlur at 16th International Conference on Luminescence (ICL-2011) June 26 – July 1 2011, Ann Arbor, Michigan, USA.
6. **Oral presentation** entitled “Controlling Particle Size and Luminescence in Mn⁴⁺ Activated K₂SiF₆” N Prasanth Kumar, **Digamber Porob**, Ravi Hanumantha, Anant A Setlur, and James Murphy at 228th ECS Meeting October 11-15, 2015 in Phoenix, Arizona USA.

US Patents/Applications

1. Green emitting phosphors and blends thereof (**2008**) Setlur, Anant Achyut; Siclovan, Oltea Puica; Nammalwar, Prasanth Kumar; Sathyanarayan, Ramesh Rao; **Porob, Digamber G.**; Chandran, Ramachandran Gopi; Heward, William Jordan; Radkov, Emil, Vergilov Valyou; Briel, Linda Jane; *US Patent No. 7,857,994*.
2. Sealing glass composition and article (**2010**) Kumar, Sundeep; Nagesh, Mamatha; **Porob Digamber**; Vishwanath, Vinayak Hassan; *US Patent No. 8,603,659*.
3. Sealing glass composition, method and article (**2010**) Park, Dong-Sil; Wu, Jian; Nagesh, Mamatha; Kumar, Sundeep; Stringer, Craig; **Porob, Digamber**; Vishwanath, Vinayak Hassan; *US Patent No. 8,043,986*.

4. Rare earth recovery from fluorescent material and associated method **(2011) Porob, Digamber Gurudas**; Srivastava, Alok Mani; Nammalwar, Prasanth Kumar; Ramachandran, Gopi Chandran; Comanzo, Holly Ann; *US Patent No. 8,137,645*.
5. Seal structure and associated method **(2011) Porob, Digamber Gurudas**; Park, Dong-Sil; Kumar, Sundeep; Saha, Atanu; *US Patent Publication No. US 2011/0223475 A1*.
6. Phosphor materials and related devices **(2011) Nammalwar, Prasanth Kumar; Setlur, Anant Achyut; Porob, Digamber Gurudas**; Manepalli, Satya Kishore; *US Patent No. 8,703,016*.
7. Core shell phosphor and method of making the same **(2011) Porob, Digamber Gurudas**; Srivastava, Alok Mani; Comanzo, Holly Ann; Ramachandran, Gopi Chandran; Nammalwar, Prasanth Kumar; *US Patent No. 8,865,305*.
8. Oxynitride phosphors, method of preparation, and light emitting instrument **(2012) Porob, Digamber Gurudas**; Setlur, Anant Achyut; Nammalwar, Prasanth Kumar; Bhat, Shyamala Halady Subraya; Manepalli, Satya Kishore; Hancu, Dan; *US Patent Publication No. US 2012/0019126A1*.
9. Method for making rare earth oxide coated phosphor **(2013) Nammalwar; Prasanth Kumar;; Srivastava; Alok Mani; Addepalli; Swarnagowri; Porob, Digamber Gurudas**; Cohen; William Erwin; Beers; William Winder *US Patent Publication No. US 2014/0178569 A1*.
10. Phosphor recovery method **(2013) Ramachandra, Srinidhi; Srivastava, Alok, Mani; Beers, William, Winder; Nammalwar, Prasanth, Kumar; Ramachandran, Gopi, Chandran; Gourishankar, Karthick, Vilapakkam; Yarra, Malathi; Porob, Digamber, Gurudas**; Jansma, Jon, Bennett; Monk, David, James; Reddy, Eddula, Sudhakar; *Patent Application No. PCT/US2013/057609 (WO2014055189A1)*
11. Phosphor materials, fluorescent lamps provided therewith, and methods therefor **(2013) Alok Mani Srivastava, Holly Ann Comanzo, William Winder Beers, Samuel Joseph Camardello, Digamber Gurudas Porob, William Erwin Cohen** *US Patent No. 9,123,525*
12. Phosphor materials and related devices **(2014) Prasanth Kumar Nammalwar, Anant Achyut Setlur, Digamber Gurudas Porob, Satya Kishore Manepalli** *US Patent No. 9,611,237*.
13. Articles for high temperature service and method for making **(2014) Kristen Hall Brosnan, Shahana Chaterjee, Wayne Charles Hasz, Mohandas Nayak, Digamber Gurudas Porob, Gopi Chandran Ramachandran, Larry Steven Rosenzweig, Shankar Sivaramakrishnan, Alok Mani Srivastava, Venkat Subramaniam Venkataramani,** *US Patent No. 9,869,188*.
14. Article and method of making thereof **(2014) Digamber Gurudas Porob, Shankar Sivaramakrishnan, Venkat Subramaniam Venkataramani, Mohandas Nayak, Gopi Chandran Ramachandran** *US Patent No. 9,920,417*

15. Process of forming phosphor particles with core shell structures (2014) Alok Mani Srivastava, Holly Ann Comanzo, William Winder Beers, Samuel Joseph Camardello, **Digamber Gurudas Porob**, William Erwin Cohen *US Patent No. 9,321,959*
16. Composite materials having red emitting phosphors (2016) Digamber Gurudas Porob, James Edward Murphy, Florencio Garcia and Megan Marie Brewster *US Patent No. 10,193,030*.
17. Methods for fabricating devices containing red line emitting phosphors (2016) **Digamber Gurudas Porob**, James Edward Murphy, Florencio Garcia, Srinivas Prasad Sista, Anant Achyut Setlur, William Winder Beers and Fangming Du *US Patent No. 9,938,457*
18. Red-emitting phosphors, processes and devices (2016) **Digamber Gurudas Porob**, Anant Achyut Setlur, Prasanth Kumar Nammalwar and James Edward Murphy *US Patent Publication No. US 2018/0051207 A1*.
19. Processes for synthesizing red-emitting phosphors and related red-emitting phosphors (2016) Ravikumar Hanumantha, Prasanth Kumar Nammalwar and **Digamber Gurudas Porob** *US Patent Publication No. US 2018/0312751 A1*
20. Coated red line emitting phosphors (2017) **Digamber Gurudas Porob**, Prasanth Kumar Nammalwar, Srinidhi Ramachandra, Matthews David Butts and James Edward Murphy *US Patent Application No. PCT/US2017/061702 (WO2018093832A2)*

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Scopus ID: 6506132903

Web of Science Researcher ID: AAT-7888-2020

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