

## Dr. Sanjay R. Dhage

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Qualification:

**M.Sc. (University of Pune)**

**Ph.D. (CSIR-NCL) (National Chemical Laboratory, Pune)**

Experience:

<b>2011 - Till date</b>	<b><i>Scientist D,</i></b> International advanced Research Center for Power Metallurgy and New Materials (ARCI) PO Balapur, Hyderabad - 500005
<b>2010 - 2011</b>	<b><i>Scientist on contract,</i></b> International advanced Research Center for Power Metallurgy and New Materials (ARCI) PO Balapur, Hyderabad - 500005
<b>2008 - 2010</b>	<b><i>Postdoctoral Researcher,</i></b> University of California Los Angeles, USA
<b>2006 - 2008</b>	<b><i>Postdoctoral Researcher,</i></b> Chonbuk National University, South Korea
<b>2005 – 2006</b>	<b><i>Research Associate,</i></b> Corporate R&D Center, Bharat Petroleum Corp. Ltd. Noida, India
<b>2001 – 2005</b>	<b><i>Research fellow,</i></b> National Chemical Laboratory, Pune India

Research Areas of Interest:

**Solar Energy Materials.**

**Thin film solar cells.**

**Solar photovoltaic device development.**

**CIGS thin film based solar cell – Pilot scale fabrication and device development.**

**CIGS thin films by sputtering and selenization/sulfurization.**

**Non-vacuum route for CIGS thin films.**

**Novel processing for thin film applications.**

**Performance testing of solar devices.**

## Publications:

### 2015

Process parameter impact on properties of sputtered large-area Mo bilayers for CIGS thin film solar cell applications, Amol C. Badgajar **Sanjay R. Dhage\***, and Shrikant V. Joshi, *Thin Solid films* (**under review**)

### 2014

Fabrication of CIGS thin film absorber by laser treatment of pre-deposited nano-ink precursor layer, **Sanjay R. Dhage\***, Manish Tak and Shrikant V. Joshi, *Materials Letter* 134 (2014) 302

CIGS absorber layer by single-step non-vacuum intense pulsed light treatment of inkjet-printed film, **Sanjay R. Dhage\***, P.S. Chandrasekhar, S.B. Chandrasekhar and Shrikant V. Joshi, *Proceedings of 40th IEEE Photovoltaic Specialist Conference* (2014) 1607-1610

### 2013

Photoluminescence properties of thermally stable highly crystalline CdS nanoparticles, **S.R. Dhage\***, H.A. Colorado and H. Thomas Hahn, *Materials Research* 16 (2) (2013) 504

### 2012

Intense pulsed light sintering technique for nanomaterials, H.A. Colorado, **S.R. Dhage**, J. M. Yang and H. Thomas Hahn, **TMS annual meeting** 1 (2012) 577

### 2011

Thermo chemical stability of CdS nanoparticles under intense pulsed light irradiation and high temperature condition, H.A. Colorado, **S.R. Dhage**, and H. Thomas Hahn, *Materials Science and Engineering B* 176 (15) (2011) 1161

Morphological variations in CdS nanocrystals without phase transformation, **S.R. Dhage\***, H.A. Colorado and H. Thomas Hahn, *Nanoscale Research Letters* 40 (2011) 122

CIGS Thin Film Preparation from CIG Metallic Alloy and Se Nanoparticles by Intense Pulsed Light Technique, **S.R. Dhage\***, Hak-Sung Kim and H. Thomas Hahn, *Journal of Electronic Materials* 40 (2011) 122

### 2010

Rapid treatment of CIGS particles by intense pulsed light, **S.R. Dhage\*** and H. Thomas Hahn, *Journal of Physics and Chemistry of Solids* 71 (2010) 1480

Polypyrrole/silicon carbide nanocomposites with tunable electrical conductivity, P. Mavinakuli, S. Wei Q. Wang, A.B. Karki, **S. Dhage** Z. Wang, D.P. Young, Z. Guo, *Journal of physical Chemistry C* 114 (2010) 3874

A simulation study on the direct carbothermal reduction of SiO<sub>2</sub> for Si metal, Hyun-Cheol Lee, **Sanjay Dhage**, M. Shaheer Akhtar, Do Hwan Kwak, Woo Jin Lee, Chong-Yeal Kim, O-Bong Yang, *Current Applied Physics* 10 (2010) S21

## 2009

Intense pulsed light sintering of copper nano ink for printed electronic technique, Hak-Sung Kim, **Sanjay R. Dhage**, Dong-Eun Shim and H. Thomas Hahn, *Applied physics A* 97 (2009) 791

Design of optimization of CIGS thin film solar cell using numerical and design of experimental approach, Ill-Woo Seok, **Sanjay Dhage**, H. Kim and H. T. Hahn, *Proceedings of the ASME 3rd International Conference on Energy Sustainability 2009, ES2009* 1, pp. 999-1003

Nanocomposites for power laminates, H. S. Kim, Y. M. Lee, **S. Dhage**, J. S. Kang and H. T. Hahn, *Proceedings of the International Conference on Compositated Materials (ICCM17) 2009*, Edniberg UK

Low temperature fabrication of hexagon shaped h-MoO<sub>3</sub> nanorods and its phase transformation, **S.R. Dhage\***, M. S. Hassan and O.B. Yang, *Materials Chemistry and Physics* 14 (2009) 511

Formation of SiC nanowhiskers by carbothermic reduction of silica with activated carbon, **S.R. Dhage**, H.C. Lee, M.S. Hassan. M.S. Akthar, C.Y. Kim, J. M. Sohn, H.S. Shin and O.B. Yang, *Materials Letters* 63 (2009) 174

## 2008

Varistor property of SnO<sub>2</sub>.CoO.Ta<sub>2</sub>O<sub>5</sub> ceramic modified by barium and strontium, **S.R. Dhage\***, V. Ravi and O.B. Yang, *Journal of Alloys and Compounds* 466 (2008) 483

## 2007

Low voltage varistor ceramics based on SnO<sub>2</sub>, **S.R. Dhage\***, V. Ravi and O.B. Yang, *Bulletin of Materials Science* 30 (2007) 583

The influence of surfactant on ZnO Varistor, **S.R. Dhage**, S.C. Navale and V. Ravi, *Ceramic International* 33 (2007) 289

## 2006

Studies on SnO<sub>2</sub>-ZrO<sub>2</sub> solid solution, **S. R. Dhage**, Violet Samuel, Renu Pasricha and V. Ravi, *Ceramic International* 32 (2006) 939

A co-precipitation technique for the preparation of ferroelectric BaBi<sub>2</sub>Ta<sub>2</sub>O<sub>9</sub>, **S.R. Dhage**, R. Pasricha, A.V. Murugan and V. Ravi, *Materials Chemistry and Physics* 98 (2006) 344

## 2005

Synthesis of bismuth oxide nanoparticles at 100 °C, M.M. Patil, V.V. Deshpande, **S.R. Dhage** and V.Ravi, *Materials Letters* 59 (2005) 2523

Preparation of ferroelectric BaNb<sub>2</sub>O<sub>6</sub> by the urea method, **S.R. Dhage**, R. Pasricha and V. Ravi, *Materials Letters* 59 (2005) 1929

Co-precipitation method for the preparation of ferroelectric CaBi<sub>4</sub>Ti<sub>4</sub>O<sub>15</sub>, S.P. Gaikwad, **S.R. Dhage** and V. Ravi, *Journal of Materials Science: Materials in Electronics* 16 (2005) 229

Synthesis of Sr<sub>0.5</sub>Ba<sub>0.5</sub>Nb<sub>2</sub>O<sub>6</sub> by urea method, **S.R. Dhage**, Renu Pasricha and V. Ravi, *Materials Letters* 59 (2005) 1053

Synthesis of fine particles of ZnO at 100 °C, **S.R. Dhage**, Renu Pasricha and V. Ravi, *Materials Letters* 59 (2005) 779

Synthesis of bismuth titanate by the urea method, M. Anilkumar, **S.R. Dhage** and V. Ravi, *Materials Letters* 59 (2005) 514

Synthesis of Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> at 100 °C, **S.R. Dhage**, S.P. Gaikwad, P. Muthukumar and V. Ravi, *Ceramic International* 31 (2005) 211

Co-precipitation method for the preparation of nanocrystalline ferroelectric SrBi<sub>2</sub>Nb<sub>2</sub>O<sub>9</sub> ceramics, S.P. Gaikwad, **S.R. Dhage**, H.S. Potdar, V. Samuel and V. Ravi, *Journal of Electroceramics* 14 (2005) 83

## **2004**

Synthesis of nanocrystalline TiO<sub>2</sub> by tartarate gel method, **S.R. Dhage**, S.P. Gaikwad and V. Ravi, *Bulletin of Materials Science* 27 (2004) 487

Synthesis of bismuth titanate by citrate method, **S.R. Dhage**, Y.B. Kholam, S.B. Dhespande, H.S. Potdar and V. Ravi, *Materials Research Bulletin* 39 (2004) 1993

Synthesis of mesoporous rutile TiO<sub>2</sub>, Violet Samuel, P. Muthukumar S.P. Gaikwad, **S.R. Dhage**, and V. Ravi, *Materials Letters* 58 (2004) 2514

Synthesis of Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> by citrate gel method, **S.R. Dhage**, S.P. Gaikwad, P. Muthukumar and V. Ravi, *Materials Letters* 58 (2004) 2704

Nonlinear I-V characteristics of doped SnO<sub>2</sub>, **S. R. Dhage** V.D. Choube and V. Ravi, *Materials Science and Engineering B* 110 (2004) 168

Synthesis of nanocrystalline TiO<sub>2</sub> at 100 °C, **Sanjay R. Dhage**, Vandana D. Choube, Violet Samuel and V. Ravi, *Materials Letters* 58 (2004) 2310

Synthesis of nanocrystalline SnO<sub>2</sub> powder at 100°C, **S.R. Dhage**, S.P. Gaikwad, Violet Samuel and V. Ravi, *Bulletin of Materials Science* 27 (2004) 221

Nonlinear I-V characteristics study of doped SnO<sub>2</sub>, **S. R. Dhage** and V. Ravi and S.K. Date, *Bulletin of Materials Science* 27 (2004) 43

## **2003**

Influence of various donors on nonlinear I-V characteristics of tin dioxide ceramics, **S. R. Dhage** and V. Ravi, *Applied Physics Letters* 83 (2003) 4539

Synthesis of ultrafine TiO<sub>2</sub> by citrate gel method, **S. R. Dhage**, Renu Pasricha and V. Ravi, *Materials Research Bulletin* 38 (2003) 1623

Co-precipitation technique for the preparation of nanocrystalline ferroelectric SrBi<sub>2</sub>Ta<sub>2</sub>O<sub>9</sub>, **S. R. Dhage**, Y. B. Kholam, S. B. Deshpande and V. Ravi, *Materials Research Bulletin* 38 (2003) 1601

Varistors based on doped SnO<sub>2</sub>, **Sanjay R. Dhage**, Violet Samuel and V. Ravi, *Journal of Electroceramics* 11 (2003) 81

Preparation of microwave dielectric, Sn<sub>0.2</sub>Zr<sub>0.8</sub>TiO<sub>4</sub>, **Sanjay R. Dhage**, V. Ravi and S.K. Date, *Bulletin of Materials Science* 26 (2003) 215

## 2002

Effect of variation of molar ratio (pH) on the crystallization of iron oxide phases in microwave hydrothermal synthesis, **S. R. Dhage**, Y. B.Kholam H. S.Potdar, S. B.Deshpande, P. P.Bakare, S. R.Sainkar, and S. K. Date, *Materials Letters* 57 (2002) 457

Influence of lanthanum on the nonlinear I-V characteristics of SnO<sub>2</sub>: Co, Nb, **Sanjay R. Dhage**, V. Ravi and S.K. Date, *Materials Letters* 57 (2002) 727

Chemical co-precipitation of mixed (Pb+Ti) oxalates precursor for the synthesis of PbTiO<sub>3</sub> powders, **S. R. Dhage**, Y. B. Kholam, H. S. Potdar, S. B. Deshpande, B. D. Sarwade, and S. K. Date, *Materials Letters* 56 (2002) 564

Microwave hydrothermal preparation of submicron-sized spherical magnetite (Fe<sub>3</sub>O<sub>4</sub>) powders, Y.B. Kholam, **S.R. Dhage**, H.S. Potdar, S.B. Deshpande, P.P. Bakare, S.D. Kulkarni, and S.K. Date, *Materials Letters* 56 (2002) 571

## **List of Patents:**

Title: Improved method of manufacturing copper-indium-gallium diselenide thin films by laser treatment.

Patent application No: 2084/DEL/2212, Date: 05/07/2012

Inventors: **Sanjay R. Dhage**, Manish Tak and Shrikant V. Joshi

## **Conference presentations:**

1. **Sanjay R. Dhage**, P.S. Chandrasekhar, S.B. Chandrasekhar and Shrikant V. Joshi, CIGS absorber layer by single-step non-vacuum intense pulsed light treatment of inkjet-printed film, Proceedings of 40th IEEE Photovoltaic Specialist Conference (2014) 1607-1610
2. H.A. Colorado, **S.R. Dhage**, J. M. Yang and H. Thomas Hahn, Intense pulsed light sintering technique for nanomaterials, **TMS annual meeting** 1 (2012) 577
3. III-Woo Seok, **Sanjay Dhage**, H. Kim and H. T. Hahn Design of optimization of CIGS thin film solar cell using numerical and design of experimental approach, *Proceedings of the ASME 3rd*

*International Conference on Energy Sustainability 2009, ES2009 1*, pp. 999-1003 **San Francisco, California USA** August 2009

4. H. S. Kim, Y. M. Lee, **S. Dhage**, J. S. Kang and H. T. Hahn, Nanocomposites for power laminates Proceedings of the International Conference on Compositated Materials (**ICCM17**) **2009**, Edniberg UK
5. **Sanjay Dhage** and H. T. Hah, Environmentally benign low cost manufacturing of CIGS thin film base solar cells, , *Annual Technology Conference, The 19<sup>th</sup> Korean-American scientist and engineer's association south west region* University of California Irvine, USA February 2009
6. **S.R. Dhage**, M. S. Hassan, H.C. Lee, O.B. Yang, Formation of Silicon carbide whiskers via carbothermic reduction of silica, *Korean Institute of Chemical Engineering (KICChE) fall meeting, October 26-27, 2007*, KAIST, Daejeon, Korea (2007)
7. **S.R. Dhage**, Y.B. Kholam, V. Ravi, Co-precipitation technique for the preparation of nanocrystalline ferroelectric  $\text{SrBi}_2\text{Nb}_2\text{O}_9$ , *Solid State Physics Symposium* Guru Nanak Dev University, Amritsar India, December 2004
8. **S.R. Dhage**, A.B. Gaikwad and V. Ravi, Influence of alkali earth (Ba and Sr) element on  $\text{SnO}_2$  based varistors, *Symposium on Materials for Automotive Industries, Materials research Society India National Chemical Laboratory, Pune India, February 2005*
9. **S.R. Dhage**, A.B. Gaikwad and V. Ravi Role of  $\text{Y}_2\text{O}_3$ ,  $\text{La}_2\text{O}_3$  and  $\text{CeO}_2$  on  $\text{SnO}_2:\text{CoO}:\text{Ta}_2\text{O}_5$  varistor, *Solid State Physics Symposium* Guru Nanak Dev University, Amritsar India, December 2004
10. **S.R. Dhage** and V. Ravi, Non-linear current-voltage characteristics of  $\text{SnO}_2$  varistor, *National seminar on Engineering Trends in Materials for Electrical Electronic and Magnetic Application*, Pune India, November 2003
11. **S.R. Dhage**, V. Ravi and S.K. Date Varistors based on  $\text{SnO}_2$ , *National Seminar on Electro and Magneto Ceramics Devices and Systems*, Akluj India, November 2002
12. **Sanjay R. Dhage**, V. Ravi and S.K. Date, Varistors based on doped  $\text{SnO}_2$  *International seminar on Recent Advances in Inorganic Material*, Indian Institute of Technology, Mumbai, India, December 2002

#### TOP 25 MOST DOWNLOADED ARTICLES WITHIN THE JOURNAL:

1. Sanjay R. Dhage, Vandana D. Choube, Violet Samuel and V. Ravi, Synthesis of nanocrystalline  $\text{TiO}_2$  at  $100^\circ\text{C}$ , *Mater. Lett.* 58 (17-18) 2310 (2004)  
July-September 2004
2. Violet Samuel, P. Muthukumar S.P. Gaikwad, S.R. Dhage, and V. Ravi, Synthesis of mesoporous rutile  $\text{TiO}_2$ , *Mater. Lett.* 58 (20) 2514 (2004)  
July-September 2004
3. S.R. Dhage, Y.B. Kholam, S.B. Dhespande, H.S. Potdar and V. Ravi, Synthesis of bismuth titanate by citrate method, *Mater. Res. Bull.* 39 (13) 1993 (2004)  
October-December 2004
4. S.R. Dhage and H. Thomas Hahn, Rapid treatment of CIGS particles by intense pulsed light, *J. Phys. Chem. Solids* 71 (2010) 1480  
July-September 2010, October-December 2010

Affiliation to Professional societies:

1. **Materials Research Society of India**
2. **Solar Energy Society of India**

Achievements and awards:

1. **Industrial postdoc fellowship, BPCL India (January 2006)**
2. **Brain Korea 21 postdoc fellowship, Chonbuk National University, South Korea (September 2006)**
3. **University postdoc fellowship, University of California Los Angeles, USA (February 2008)**
4. **Publications in peer-reviewed international journals: 45 (All-together citations- 847, *h index* - 17, Source: [www.scopus.com](http://www.scopus.com))**

Editorial board member of Journals:

1. **Recent Advancement in Physics and Astronomy**
2. **International Journal of Innovative Research and Review**
3. **Dataset Papers in Science**

Frequent reviewer of Journals:

1. **Solar Energy Materials and Solar cells**
2. **Materials Chemistry and Physics**
3. **Journal of Alloys and compounds**
4. **Superlattice and Microstructures**
5. **Journal of Solid State Chemistry**
6. **Journal of colloid and interface science**
7. **Synthetic metals**
8. **Composite science and technology**
9. **Journal of composite materials**
10. **ACS Applied Materials and Interphases**
11. **Nanoscale Research Letters**
12. **Review of scientific instruments**
13. **Journal of Nanoparticles Research**
14. **Advanced Energy Materials**
15. **Advanced Engineering Materials**
16. **Scientific Reports**