

# Dr. Amit Kumar Srivastava

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## EDUCATION

### **Ph. D. (Materials Science, CPI 9.0/10)**

Indian Institute of Technology Kanpur (May 2014).

Thesis title- On the characterization and band gap narrowing effect of spin-coated zinc oxide based transparent conducting thin films

### **M. Tech. (Materials Science, CPI 8.62/10)**

Indian Institute of Technology Kanpur (March 2007).

Project title- Preparation, microstructure and optical absorption studies of spin coated NiO, ZnO and Ni-containing zinc oxide thin films

### **M. Sc. (Physics with electronics, 70.3%, First division)**

D. D. U. Gorakhpur University, Gorakhpur (2000-2002).

### **B. Sc. (Physics and Electronics, 68.1%, First division)**

D. D. U. Gorakhpur University, Gorakhpur (1997-2000).

## ACADEMIC ACHIEVEMENTS

1. Qualified, National Eligibility Test (NET) - Council of Scientific and Industrial Research (2004).
2. Qualified, Graduate Aptitude Test in Engineering (GATE-2004), Physics, Score-95.69 (All India Rank 119 out of 2804).
3. Recipient of Certificate of Merit for academic excellence in M. Tech. (Material Science), I. I. T. Kanpur (2007).

## TEACHING EXPERIENCE

- Lecturer, Department of Physics, DDU Gorakhpur University, Gorakhpur, 2004-05 (six months).
- Teaching assistant, Characterization of Materials, I. I. T. Kanpur (4 times during 2006-11).
- Guest faculty, MMM University of Technology, 2014 -2015 (Ten months).
- Assistant Professor (Physics), SRM University, Lucknow, 2016-2017 (1 year and 10 months)
- Assistant Professor (physics) under TEQIP III, Government Engineering College Ajmer, Jan 2018- onwards

## BRIEF REPORT OF RESEARCH WORK

The research work encompasses development of low cost indium free transparent conducting oxide (TCO) for variety of applications, viz., flat panel displays, light-emitting devices, and solar cells etc. Currently, indium-tin oxide (ITO) is used due to its wide energy band gap ( $E_g$ )  $\sim$  3.50-4.05 eV, high optical transmittance ( $T$  %)  $\sim$ 90% in the visible range and low electrical resistivity ( $\rho$ )  $\sim$ 10<sup>-4</sup>  $\Omega$ -cm. However, indium has limited resources. Zinc oxide meets some of the requirements (e.g.,  $E_g$   $\sim$  3.00-3.40 eV, transmittance  $\sim$  90%) but its electrical resistivity is too high ( $\sim$  10<sup>6</sup>- 10<sup>10</sup>  $\Omega$ -cm). So, it is

essential to find a way for reducing  $\rho$  of ZnO appropriately via doping and/ or heat treatment. The work involves preparation of metal (Ga, Al) doped ZnO thin films by low cost spin- and dip-coating techniques, optimization of various experimental parameters such as spinning/ withdrawal speed, time, annealing conditions (temperature and environment), and characterization with regard to structure, optical absorption and electrical parameters. The investigation led to successful preparation of ZnO thin films on glass/ quartz substrate with judicious control of Al/ Ga doping level, heat treatment in air and vacuum in succession, and filling of cation vacancies with additional zinc species. Thus, the lower electrical resistivity of  $9 \times 10^{-3} \Omega\text{-cm}$  with optical transmittance 80-100 %T in the visible range has been achieved. In addition, a new expression explaining the band gap narrowing in the semiconductors is proposed as  $\Delta E_{\text{BGN}} = Bn^{1/3} [1-(n_c/n)^{1/3}]$ , where B is the fitting parameter, n is carrier concentration and  $n_c$  is the critical density required for shrinkage onset.

## PUBLICATIONS

- 1) Effect of precursor solvent on the opto-electrical properties of spin coated transparent conducting ZnO: Ga thin films,  
Amit Kumar Srivastava and Jitendra Kumar  
Materials Chemistry and Physics, **162** (2015) 436-441 (6 pages).
- 2) Band gap narrowing in zinc oxide-based semiconductor thin films,  
Jitendra Kumar and Amit Kumar Srivastava  
Journal of Applied Physics, **115** (2014) 134904 (7 pages).
- 3) Effect of zinc addition and vacuum annealing time on the properties of spin-coated low-cost transparent conducting 1at% Ga-ZnO thin films,  
Amit Kumar Srivastava and Jitendra Kumar  
Science and Technology of Advanced Materials, **14** (2013) 065002 (15 pages).  
**Most popular article in STAM 2013 (Available on journal website as highlights of 2013)**
- 4) Effect of swift heavy ion irradiation on optical and structural properties of amorphous Ge-As-Se thin films,  
Rashmi Chauhan, Arvind Tripathi, Amit Kumar Srivastava and Krishna Kant Srivastava  
Chalcogenide Letters, **10** (2013) 63-71.
- 5) On the emergence of a stabilized cubic phase in pure zirconia thin films at room temperature,  
Gurudayal, Amit Kumar Srivastava and Jitendra Kumar  
Materials Letters, **83** (2012) 172-174.
- 6) Effect of aluminum addition on the optical, morphology and electrical behavior of spin coated zinc oxide thin films,  
Amit Kumar Srivastava and Jitendra Kumar  
AIP Advances, **1** (2011) 032153 (11 pages).
- 7) Linear and nonlinear optical changes in amorphous  $\text{As}_2\text{Se}_3$  thin film upon UV exposure,  
Rashmi Chauhan, Amit Kumar Srivastava, Arvind Tripathi and Krishna Kant Srivastava,  
Progress in Natural Science: Materials International, **21** (2011) 205-210.
- 8) Photo-induced optical change in  $\text{Ge}_x\text{As}_{40}\text{Se}_{60-x}$  thin films,  
Rashmi Chauhan, Amit Kumar Srivastava, Arvind Tripathi and Krishna Kant Srivastava,  
Progress in Natural Science: Materials International, **20**, (2010) 54-60.
- 9) Effect of UV Exposure on Some Optical Properties of As-Se Based Chalcogenide Glasses,  
Rashmi Chauhan, Amit Kumar Srivastava, Madhu Mishra and Krishna Kant Srivastava,  
Integrated Ferroelectrics, **119** (2010) 22-32

- 10) Preparation, microstructure and optical absorption behavior of NiO thin film,  
Amit Kumar Srivastava, Subhash Thota and Jitendra Kumar,  
Journal of Nanoscience and Nanotechnology, **8** (2008) 4111-4115.

## CONFERENCE PROCEEDINGS

- 1) Effect of swift heavy ion irradiation on optical properties of amorphous As<sub>2</sub>Se<sub>3</sub> thin films,  
Rashmi Chauhan, Arvind Tripathi, Amit Kumar Srivastava, and K. K. Srivastava,  
AIP Conference Proceedings, **1536** (2013) 599-600
- 2) Photoinduced effect in Te-As-Se thin films for photonic applications,  
Rashmi Chauhan, Amit Kumar Srivastava, Arvind Tripathi, M. Mishra, and K. K. Srivastava,  
SPIE Proceedings, **8173** (2011) 81731C
- 3) On the sol-gel synthesis and characterization of titanium oxide nanoparticles,  
Varun Chaudhary, Amit Kumar Srivastava and Jitendra Kumar,  
MRS Proceedings, **1352** (2011) mrss11-1352-gg10-24

## CONFERENCES

### Oral presentations

- 1) Effect of precursor solvent on the nature of spin coated 1at%Ga-ZnO transparent conducting films,  
Amit Kumar Srivastava and Jitendra Kumar  
20<sup>th</sup> International Conference on Solid State Ionics, E: Transparent Conducting Oxides,  
Keystone,  
June 14-19, 2015, Colorado, **USA**.
- 2) Effect of solvents on the optical and electrical behaviour of spin coated gallium doped ZnO thin films,  
Amit Kumar Srivastava and Jitendra Kumar,  
International Conference on Materials for Advanced Technologies (ICMAT)-2013,  
June 30 - July 5, 2013, Suntec, **Singapore**.
- 3) Preparation and optical studies of Cd<sub>1-x</sub>Zn<sub>x</sub>O (0<x<1) thin films,  
Amit Kumar Srivastava, Sunil Dhankhar and Jitendra Kumar,  
Recent Advances in Condensed Matter Physics (RACMP)-2009,  
May 23-24, 2009, NIT Hamirpur, **India**.
- 4) Effect of sol-molarity, annealing temperature and nickel concentration on the optical behavior of  
Zn<sub>1-x</sub>Ni<sub>x</sub>O (0<x<0.3) thin films,  
Amit Kumar Srivastava and Jitendra Kumar,  
International Conference on Electronic Materials (ICEM)-2008,  
July 28 - August 1, 2008, Sydney, **Australia**.

### Poster presentations

- 1) Development of spin coated ZnO Based Transparent conductor thin films,  
Amit Kumar Srivastava and Jitendra Kumar,  
MRS Spring meeting- 2012,  
April 9-13, 2012, San Francisco, California, **USA**.

- 2) Nature of aluminum doped ZnO thin films prepared by pulsed laser deposition, Amit Kumar Srivastava, Bhupesh Kumar, R. K. Thareja and Jitendra Kumar, International Conference on Nano Science and Technology (ICONSAT)-2012, January 20-23, 2012, ARCI, Hyderabad, **India**.
- 3) On the optical and electrical behaviour of spin coated gallium doped ZnO thin films, Amit Kumar Srivastava and Jitendra Kumar, Micro Solar Energy Generation and Utilization, September 3-4, 2011, IIT Kanpur, Kanpur, **India**.
- 4) On the electrical and optical behaviour of aluminum doped ZnO thin films, Amit Kumar Srivastava, and Jitendra Kumar, International Conference on Nano Science and Technology (ICONSAT)-2010, February 17-20, 2010, IIT Bombay, Mumbai, **India**.
- 5) Preparation, microstructure and optical absorption behavior of NiO thin films, Amit Kumar Srivastava, Subhash Thota and Jitendra Kumar, Advance Nano Materials (ANM)-2007, January 8-10, 2007, IIT Bombay, Mumbai, **India**.

#### **SCHOOL/ WORKSHOP/ TUTORIALS ATTENDED**

- 1) Winter School on 'New Carbon Materials and Functional Oxide', Bangalore, December 8-13, 2008  
Organized by International Centre for Materials Science (ICMS), Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and International Centre for Materials Research (ICMR), University of California, Santa Barbara (UCSB).
- 2) Workshop on 'Conservation of Medicinal Plants', Gorakhpur, March 2-3, 1997, Organized by the Living World Society.
- 3) Tutorials during International Symposium/ Seminar at IIT Kanpur
  - a) Photovoltaic Science and Technology, January 12, 2010.
  - b) Micro Solar Energy Generation and Utilization, September 2-3, 2011.

#### **ORGANIZATIONAL ACTIVITY**

Science Exhibition and Lecture Workshop, Gorakhpur, February 28, 2015, Madan Mohan Malaviya University of Technology, Gorakhpur