

Smita Chaturvedi, Ph. D. (Fulbright Nehru Academic and Professional Fellow-2018-19)

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Fields of Interest:

Multiferroics and magnetic nanomaterials. Structural and physical properties investigations and optimization to achieve multiferroicity for compact and ultralow energy devices applications. Nanogenerator applications.

Education:

Ph. D. : Solid State Physics: Rani Durgavati University, Jabalpur, M. P. India	2003
M.Sc. : Physics: Rani Durgavati University, Jabalpur, M.P., India	- 71% 1996
B.Sc. : Phys., Chem., Maths: Rani Durgavati University, Jabalpur, M.P., India	- 75% 1994
S.S.C. : Phys., Chem., Maths: M.P. Board, India	- 80% 1991

Professional positions:

• Assistant Professor (Physics) IDSS, Savitribai Phule Pune University, Pune.	Sept. 2019 - to date
• Project Scientist (DST-WoS A) Indian Institute of Science Education and research, Pune	Nov. 2016 - Sept.2019
• Project Scientist (DST-WoS A) Indian Institute of Science Education and research, Pune.	Oct. 2013 - Oct.2016
• Honorary Research Associate Oakland University, Michigan, USA	Apr. 2010 - Mar. 2011
• Research Associate Indian Institute of Technology, Bombay	Nov. 2002 - Nov. 2004
• Visiting Lecturer Dept. of Physics, Rani Durgawati University, Jabalpur	Jul. 1998 - Mar. 1999
• Full time lecturer Govt. Auto. Model Science College, Jabalpur	Aug. 1997 - Oct. 2001

Teaching Experience, student mentoring and Courses taught:

Assistant Professor Physics, IDSS, SPPU Pune Sept.2019- to date

Savitribai Phule Pune University is one of the finest and most popular educational centres in the country. The University is ranked 7th among universities in India, in 2018, by the Times Higher Education.

• Teaching basic physics to B Sc Blended course.
DST Project Scientist, IISER Pune Oct. 2013 -Sept.2019

IISER Pune is a research-intensive teaching institute. It is ranked #23 by Careers 360's Top Universities in India in 2017 and its NIRF (National Institute Ranking Framework) ranking is 29 in the overall category of universities.

- Mentored BS-MS students for their summer projects and final year project.

Lecturer, Govt. Model Science College, Jabalpur

Aug. 1997 to Oct. 2001

The Govt. Model Science College is considered as educational hub and accredited as 'A' level college by NAC (National Accreditation Committee, New Delhi). My experience with students was very positive and enriching, and here is the list of courses I taught during my teaching.

- Analog and Digital Electronics – Amplifiers and Oscillators, IC fabrication, IC circuits, Operational (Undergraduate class 2 semesters – 32 students)
- Crystal structure (Undergraduate class 2 semesters – 32 students)
- Condensed Matter Physics – C and its use for numerical problem solving. (Undergraduate class 2 semesters – 32 students)
- Mentored undergraduate and graduate students to solve their subject related problems and advised them for different career paths. Mentored about six students for their Master's degree project work and thesis.

Visiting lecturer, Rani Durgavati University, Jabalpur, India

Jul. 1998 to Mar. 1999

- Solid State Physics and Material Science (Postgraduate/ Master Level – 20 students, 2 semesters)
- Crystallography (Postgraduate level – 32 students, 2 semesters)

Administrative Experience:

Full time lecturer, Govt. Model Science College, Jabalpur, India

Aug. 1997 to Oct. 2001

- Organized weekly graduate level seminars.
- Participated in undergraduate and graduate level admission process by analyzing applications.
- Organized yearly science exhibition.
- Involved in evaluation of graduate and undergraduate final exams.

Part time lecturer, Rani Durgavati University, Jabalpur, India

Jul. 1998 to Mar. 1999

- Part of organization committee for "National seminar on Luminescence and its Application"

Research Grants and Awards Received:

- | | | |
|---|----------------------|------------------|
| • Fulbright Nehru Academic and Professional Excellence Award-2018-19 | UDS 15000 | Oct.2018 |
| • DST WoS-A | INR 29,55,000 | Nov. 2016 |
| • DST WoS-A | INR 26,00,000 | Oct. 2013 |

Recent Publications:

1. Chaturvedi S.*, Shyam P., Shirolkar M. M., Krishna S., Sinha B., Caliebe W., Kalinko A., Srinivasan G., Ogale S. "Tunable magnetization in nanoscale LuFeO₃: Role of morphology, ortho-hexa phase ratio and local structure" arXiv:1908.02073 [cond-mat.mtrl-sci]
2. Chaturvedi S.*, Singh S.K., Shyam P., Shirolkar M. M., Krishna S., Boomishankar R.* and Ogale S. "Nanoscale LuFeO₃: shape dependent ortho/hexa-phase constitution and nanogenerator application" **Nanoscale**, 10, 21406-21413, 2018.
3. Chaturvedi S*, Shyam P., Bag R., Shirolkar M., Kumar J., Awasthi A. M. et al., "Nanosize effect: Enhanced compensation temperature and existence of magneto-dielectric coupling in SmFeO₃" **Phys. Rev. B**, 96, 024434, **2017**.
4. Chaturvedi S., Shyam P., Apte A., Kumar J., Awasthi A. M. and Kulkarni S., "Dynamics of electron density, spin-phonon coupling and dielectric properties of SmFeO₃ nanoparticles at spin reorientation temperature: The role of exchange striction". **Phys. Rev. B** 93, 174117, **2016**. Impact Factor 4.7
5. Chaturvedi S., Bag R., Sathe V., Kulkarni S. and Singh S., "Holmium induced enhanced functionality at room temperature and structural phase transition at high temperature in bismuth ferrite nanoparticles", **J. Mater. Chem. C**, 4, 780, **2016**. Impact Factor 4.7
6. Shyam P., Chaturvedi S., Karmakar K., Bhattacharya A., Singh S. and Kulkarni S., Structural and magnetic investigations on wet chemically synthesized nanoscale S=1/2 spin chain compound – CuSe₂O₅", **J. Mater. Chem. C**, 4, 611, **2016**, Impact Factor:4.7
7. Chaturvedi, S.*; Das, R.; Poddar, P.; Kulkarni, S. "Tunable Band Gap and Coercivity of Bismuth Ferrite–polyaniline Core–shell Nanoparticles: The Role of Shell Thickness." **RSC Adv.**, 5 (3), 23563–23568, **2015**. Impact Factor:3.9
8. Chaturvedi, S.; Sarkar, I.; Shirolkar, M. M.; Jeng, U.-S.; Yeh, Y.-Q.; Rajendra, R.; Ballav, N.; Kulkarni, S. "Probing Bismuth Ferrite Nanoparticles by Hard X-Ray Photoemission: Anomalous Occurrence of Metallic Bismuth." **Appl. Phys. Lett.** 105 (10), 102910, **2014**. Impact Factor: 3.5
9. Apte, A.; Bhaskar, P.; Das, R.; Chaturvedi, S.; Poddar, P.; Kulkarni, S. "Self-Assembled Vertically Aligned Gold Nanorod Super-Lattices for Ultra-High Sensitive Detection of Molecules", **Nano Research**, 8(3), 907-919, **2014**. Impact Factor:8.8
10. Chaturvedi, S.; Shirolkar, M. M.; Rajendra, R.; Singh, S.; Ballav, N.; Kulkarni, S., "Coercivity and Exchange Bias of Bismuth Ferrite Nanoparticles Isolated by Polymer Coating". **J. Appl. Phys.** 115, 123906, **2014**. Impact Factor:2.19

Publications during Ph. D. (maiden name: Smita Sengar)

11. S. Sengar S.J. Dhoble and B.P. Chandra, Anti-Stokes luminescence in Pr³⁺ activated crystalline ZBLAN fluoride phosphor, Indian J.Phys.79(4) 355-36, **2005**. Impact Factor:1.3
12. S. Sengar, S.J. Dhoble, B.P. Chandra and B.C. Bhatt Photoluminescence and thermoluminescence in Pr³⁺ activated ZBLAN fluoride crystalline phosphor, Indian J.phys.76A (6).531-535, **2002**. Impact Factor:0.77
13. S. Sengar, S.J. Dhoble, D-S Raghuvanshi and B.P. Chandra, Temperature dependence of Anti-Stokes luminescence in ZBLAN: Pr³⁺; Indian Journal of Pure and Applied physics, vol.41, 575-577, **2003**. Impact Factor:1.38

Papers in National and International conferences:

1. S. Kishna, P. Shyam, **S. Chaturvedi** and S. Ogale "Structure and morphology induced effect on properties of BaTiO₃-HoFeO₃ nanofiber composite" Poster at the International Conference on Nanoscience and Technology – ICONSAT 2017 (November 2017), IISc, Bangalore, India.
2. **S. Chaturvedi**, P. Shyam, A. Apte and S. Kulkarni, "Visualizing the effect of chemical pressure using electron density maps of RFeO₃ (R = Sm, Ho, Lu) nanoparticles", Poster at the International Conference on Nanoscience and Technology – ICONSAT 2016 (29 February – 2 March, 2016), IISER, Pune, India.
3. **Chaturvedi S.**, Dhoble S.J, Chandra B.P., Concentration Dependence of Stokes luminescence in Pr³⁺-Activated ZBLAN Fluoride Crystalline Phosphor : International Conference in Luminescence and its

- Applications , BARC, India February 9-12, **2004**.
4. Gedam S.C., **Chaturvedi S.**, Dhoble S.J. and Moharil S.V., Solid State synthesis of hollow sulfate based advanced materials, Proceeding of National Seminar on Advanced Materials Kamla Nehru Mahavidyalaya, Nagpur, India. pp. 58-61, (NSAM-2004), 1st Feb **2004**.
 5. **Senger S.**, Dhoble S.J., and Chandra B.P., Synthesis and Characterization of Pr³⁺ Activated ZBLAN Fluoride Crystalline Optoelectronic material for IR Detector, 2nd International Conference on materials for Advanced Technologies & IUMRS Singapore (*Symposium B*) Aabst. No. B-12-9-P, Dec 10-12, **2003**.
 6. Gedam S.C., **Chaturvedi S.**, Dhoble S.J. and Moharil S.V., Solid State synthesis of hollow sulfate based advanced materials, Proceeding of National Seminar on Advanced Materials Kamla Nehru Mahavidyalaya, Nagpur, India. pp. 58-61, (NSAM-2004), 1st Feb **2004**.

Research Highlights:

- **IoT energy crisis: Multiferroic/magnetoelectric nanomaterials and heterostructures for ultralow energy devices.**

FNAPF, Oakland University Michigan USA

Oct 2018 – Jul 2019

The Internet of Things is leading to extensive use of microelectronics and consumption of half of global energy by 2030! Multiferroic materials, possessing more than one ferroic order are promising solution. Lutetium orthoferrite demonstrates the co-existence of ortho- and hexa-LuFeO₃(o-h LFO) at nanoscale as observed by us. two different phases(hexa and ortho) serve as two independent source of ferromagnetism and ferroelectricity, hence providing multiferroicity in a single material. We plan to Optimize nanocomposites of o-h LFO combining with other functional materials, in the form of core-shell structure and/or thin films to achieve functionality for ultra-low energy devices.

- **Nanocomposites of rare earth orthoferrites RFeO₃: An approach towards multiferroicity.**

DST-WoS-A Project Scientist at IISER Pune, India

Nov. 2016 - to date

Plan to study nanoparticles and nanocomposites of four significant and promising RFeO₃ compounds and tailor their physical properties by means of doping and/or combining them with another functional material (nanocomposite) to improve their performance. We intend to focus on LaFeO₃, SmFeO₃, HoFeO₃ and LuFeO₃. These orthoferrites are distinctly different from each other in terms of chemistry involved, as La has a completely empty '4f₀' shell, Sm has a half filled '4f₆' shell, Ho has more than half filled '4f₁₁' and Lu has completely filled '4f₁₄' shell. Their ionic radii are significantly different

- **Synthesis of BiFeO₃–Polyaniline core-shell (c/s-BFO-PANI) nanoparticles and their magnetic and dielectric characterization.**

DST- WoS-A Project Scientist at IISER Pune, India

Oct. 2013 - Oct.2016

Structural changes due to coating of PANI and also due to change in size of the nanoparticles are investigated. Use of XPS and HXPES to analyze surface as well as interface of the core-shell. Magnetic characterization and changes in magnetic behavior were investigated and analyzed by means of structural changes in oxygen octahedra in BFO as well as change in B site symmetry. Doping Lanthanides like holmium, in BFO and changes in structure and magnetic properties due to doping were also investigated.

- **"Passive, Highly-sensitive, Room temperature Magnetic Field Sensors and Arrays for detection and Imaging of Hidden Threats in Urban Environments".**

Honorary Research associate at Oakland University, Michigan, USA

Apr. 2010 - Mar.2011

Studied domain structure, and changes in domain size, shape and henceforth changes in magnetic properties of the nanocomposites by means of magnetic force microscopy, using advanced scanning probe microscope.

- **“Ultra-thin layered multilayer mirrors for water window soft X-rays by pulsed laser deposition”**

Research Associate at IIT Bombay, India

Nov. 2003 – Nov. 2004

Ultra-thin (alloy/ceramic oxide) multilayer mirrors made by PLD, with periods as low as 2.4 nm suited for water window. The structure of these thin continuous films was optimized to achieve the highest reflectivity for water window soft X rays. Additionally the temporal and thermal stability of the multilayered structures were also investigated. These XRR Measurements were done to determine accurately the thickness, density, roughness and pore size distribution of single and multilayer thin films.

- **“Structure property relationship in some magnetic and semi-conducting materials”**

Research Associate at IIT Bombay, India

Nov. 2002 - Nov. 2003

Structural analysis using Reitveld refinement of single crystal of spin one Heisenberg anti-ferromagnetic compound Y_2BaNiO_5 ($s=1$) (YBNO) prepared by solid state reaction. Diffraction data for single crystal was analyzed to understand structural contribution towards the magnetic behavior of the material.

Projects at synchrotron beam lines:

- **'Low temperature XAFS investigation of $SmFeO_3$ at nano and micro scale in order to understand enhanced compensation temperature.**

PETRA III, DESY, Germany: I- 20170276

Dec. 2017

The substantial differences observed in the crystal structures and magnetic properties of the $SmFeO_3$ nano- and micro-particles urged us to find out the local structure of these two particles using EXAFS. A systematic study probing the local structure modification due to grain size was planned to shed light on the differences deduced by crystallography studies. This gave a better understanding of the relation between the structural and magnetic properties in these compounds.

- **Electronic structure study of spin impurity doped and undoped one-dimensional spin half chains in Sr_2CuO_3 single crystals.**

PETRA III, DESY, Germany: I-20150525

June 2016

X ray Photoelectron Spectroscopy measurements were performed on doped (Ni and Co from 1% to 5 %) and undoped Sr_2CuO_3 single crystals at the HAXPES end station of P09 beamline. High resolution is a prerequisite to separate effect of doping on spinon and holon states in the valence band and the associated satellite feature in the core level. We measured the VB region ($EF=0$ to 15 eV), Sr3d, Cu2p, Ni2p and O1s at RT, 100K, 50 K and 30K.

- **Low Temperature Synchrotron X-ray diffraction study of newly discovered multiferroic lutetium orthoferrite doped and undoped $LuFeO_3$ Nanoparticles.**

KEK, Photon Factory, Japan: 2015-IB-32

Nov. 2015

Carried out XRD of $LuFeO_3$, $HoFeO_3$ and Ho doped $LuFeO_3$ samples from ~ 25 K to 300 K. The high resolution synchrotron data was used to understand the effect of Ho concentration on structural and in turn on magnetic and dielectric properties. We determined the structure (phases, co-ordinations, bond angles and bond lengths) by Rietveld analysis to correlate the structural, magnetic and dielectric properties.

- **Room and Low Temperature Synchrotron X-ray diffraction study of Rare Earth Orthoferrite $RFeO_3$ (R=Sm, Dy) Nanoparticles.**

KEK, Photon Factory, Japan: 2015-IB-05

June 2015

High and low temperature X-ray diffractions of rare earth orthoferrite SmFeO₃ (SFO) and DyFeO₃ (DFO) nanoparticles using synchrotron radiation have been performed. The X-ray diffraction data used in revealing the structural changes, rare earth orthoferrites undergo during the spin reorientation and Néel temperatures transition.

- **Low Temperature Synchrotron X ray diffraction study of quasi-one dimensional Heisenberg (S=1/2) Antiferromagnet Copper (II) diselenium pentoxide (CuSe₂O₅) nanoparticles.**

KEK, Photon Factory, Japan: 2015-IB-05

June 2015

The low-temperature effects on the lattice parameters of the CuSe₂O₅ nanoparticles were investigated. Intriguing finite size effects (e.g. strain, spin-chain confinement, etc.) at the nanoscale were probed via high-resolution, intense X-ray diffraction.

Professional Employment Record

Name and Address of employer	Period of From	Service To	Designation of the post held	Detailed description of work
Oakland University Michigan USA	23-10-2018 15-05-2019	23-12-2018 15-07-2019	Fulbright Nehru academic and professional Excellence Fellow	Collaborative research work on nanoscale multiferroic materials for IoT devices
Indian Institute of Science Education and Research Pune	14-11-2016	23-09-2019	Project Scientist (DST WoS-A)	Research work towards nano-composites of rare earth ferrites
Indian Institute of Science Education and Research Pune	14-10-2013	13-10-2016	Project Scientist (DST WoS-A)	Research work towards physical and structural properties of multiferroic bismuth ferrite NPs
Oakland University Michigan USA	01-04-2010	31-03-2011	Honorary Research Associate	Research work on multiferroic composites
Indian Institute of Technology Bombay	26-11-2003	26-11-2004	Research Associate	Research and teaching Associateship
Indian Institute of Technology Bombay	26-11-2002	25-11-2003	Research Associate	Research and Teaching Associateship
Govt. Auto. Model Science College, Jabalpur	20-01-2000	10-10-2001	Full time substitute lecturer by UGC	Teaching physics to U.G. & P.G. level (basic electronics and solid state physics)
Dept. of Physics, Rani Durgawati University, Jabalpur	15-07-1998	30-03-1999	Guest lecturer	Teaching electronics and c programming to M.Sc. (Elec.) classes
Govt. Auto. Model Science College, Jabalpur	09-08-1997	24-12-1999	Lecturer on ad-hoc basis	Teaching physics to U.G. & P.G. classes

Total experience as on March 2019:

3.6 years (42 month) teaching

8.7 years (103 months) research and teaching

Workshops attended:

- “National Instruments Technical Symposium on latest trends in Technology. “
Troy Michigan, USA Nov.2007
- “X Ray Diffraction analysis for Pharmacy Industries.”
IIT Bombay, India Jul. 2004
- “Workshop on microprocessor based real time system in Physics.”
ICTP, Trieste, ITALY Nov. 2002

Memberships:

Organization for Women in Science for the Developing World (OWSD) Full member since Aug.2016

Awards:

Fulbright Nehru Academic and Professional Fellowship FNAPE 2018-2019 2018
DST-WoS-A Fellowship 2016
DST-WoS-A Fellowship 2013
Merit Award M. Sc. 1996
Merit Award High School 1991

References:

Satishchandra Ogale,

(Familiar with present work)

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Gopalan Srinivasan

(Fulbright Host in USA)

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(Postdoc supervisor)

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