

## KOYAL SUMAN SAMANTARAY

PRIME MINISTER RESEARCH FELLOW (ID 2100558)

Graduating Ph.D. Scholar

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<https://www.koyalsuman.com/>, <https://iiti.ac.in/page/pmrf-fellows>



### RESEARCH INTEREST:

- Structure-Property Correlation
- Ferroelectrics/Piezoelectrics
- Light-Matter interaction
- Polarons/Ferroelectric Polarons
- Device fabrication using Thin-film Technology
- Piezo-phototronic Coupling

### EDUCATION:

Academic Year	Course	CGPA/Percentage		Institute
2019-2020	Ph.D. Course work (Dept. of Physics) (2020)	CGPA-9.22		Indian Institute of Technology, Indore, India
2013-2018	5-Yr Integrated MSc. in Physics (Dept. of Physics and Astronomy) (2018)	Undergraduate (2013-2016)	Postgraduate (2016-2018)	National Institute of Technology, Rourkela, India
		CGPA: 8.44	CGPA-9.01	
2011-2013	Intermediate in Science (2013)	Percentage – 86.82		BJB Junior. College, Bhubaneswar, Odisha, India
2011	Matriculation (2011)	CGPA: 10		Jawahar Navodaya Vidyalaya, Mundali, Cuttack, Odisha, India

### AWARDS AND FELLOWSHIPS

- ❖ **2023 (DEC):** Awarded “**Best Poster Presentation (Registration Fee Grant)**” at 2<sup>nd</sup> International Conference on Advances on Nanomaterials and Devices for Energy and Environment (CANDEE) held at ABV-IIITM, Gwalior, India.
- ❖ **2020 (MAY):** Awarded with Most Prestigious Fellowship in India (**Prime Minister Research Fellowship-PMRF**) to Pursue Ph.D. degree (2019-2024).
- ❖ **2018 and 2019:** Qualified **Graduate Aptitude Test in Engineering (GATE)**.
- ❖ **2018:** Awarded **Rank 2 in the Five Yr. Integrated MSc Program** at NIT, Rourkela, Odisha, India.
- ❖ **2016-17, 2015-16:** Awarded for best in academic performance at NIT, Rourkela, Odisha, India.

## PROJECTS:

- ❖ Thin film fabrication of  $\text{Ba}_{0.75}\text{Sr}_{0.25}\text{TiO}_3$  lead-free perovskites using RF sputtering.
- ❖ Piezo-photocatalysis of NBT-based nanofibers grown using Electrospinning: An experimental and theoretical approach using first principle calculations.
- ❖ Crossover from a small polaron to large polaron hopping at depolarization temperature of BCZT-modified NBT ceramics.
- ❖ Understanding the depolarization temperature of  $\text{Ba}_{0.85}\text{Ca}_{0.15}\text{Ti}_{0.90}\text{Zr}_{0.10}\text{O}_3$  modified  $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$  lead-free ceramics.
- ❖ Investigating the effect of electric field on  $\text{Ba}_{0.85}\text{Ca}_{0.15}\text{Ti}_{0.90}\text{Zr}_{0.10}\text{O}_3$  modified  $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$  lead-free ceramics.
- ❖ Influence of electric field on transport properties of BCZT-modified NBT ceramics.

## WORKSHOPS AND CONFERENCES:

- ❖ Invited **Oral Presentation** at 5<sup>th</sup> Virtual Congress on Materials Science & Engineering held online (Sept. 26-29, 2022). [2022 (SEP)]
- ❖ **Short talk** at Quality Improvement Programme (QIP) held at IIT Indore. [2022 (MAR)]
- ❖ **Oral Presentation** at International Conference on Technologies for Smart Green Connected Society 2021 (ICTSGS). [2021 (NOV)]
- ❖ **Oral Presentation** at the International Conference on Current Trends in Material Science and Engineering (CTMSE).[2021 (MAR)]
- ❖ **Oral Presentation** at 2<sup>nd</sup> International Conference on Processing and characterization of Materials (ICPCM) held at NIT-Rourkela.[ 2019 (DEC)]
- ❖ Presented **Poster** on “Temperature induced electrical properties of BST thin film” at 2<sup>nd</sup> International Conference on Advances on Nanomaterials and Devices for Energy and Environment (CANDEE) held at ABV-IIITM, Gwalior, India. [2023 (DEC)] [BEST POSTER AWARD]
- ❖ **Poster** Presentation at the International Conference on Nanoscience and Nanotechnology (ICONN). [2021 (FEB)]
- ❖ Attended the “School on Fundamental Crystallography and Workshop on Rietveld Refinement Analysis (SFCWRRRA-2023)” held at NIT Rourkela, India.[ 2023 (JUL)]
- ❖ Participated in International Webinar on Frontiers in Experimental Physics (IWFEP).[ 2020 (AUG)]
- ❖ International School on Fundamental Crystallography and Workshop on Structural Phase Transitions: A Satellite School of 24<sup>th</sup> IUCr Congress, 2017 at National Institute of Technology, Rourkela.[ 2017 (SEPT)]

## PUBLICATIONS:

### FIRST AUTHORS:

#### Thesis:

- **Crossover from small polaron to large polaron hopping in NBT-based ceramics at depolarization temperature**, [Koyal Suman Samantaray](#), Maneesha P, and Somaditya Sen\*. (Submitted in Physical Review B).
- **Unveiling the Direct Piezoelectric Effect on Piezo-phototronic Coupling in Ferroelectrics: A First Principle Study Assisted Experimental Approach**, [Koyal Suman Samantaray](#), Sourabh Kumar, Maneesha P, Dilip Sasmal, Suresh Chandra Baral, B.R. Vaishnavi Krupa, Arup Dasgupta, K Harrabi, A Mekki, and Somaditya Sen\*, (Submitted in ACS Nano).
- **Understanding the Depolarization Phenomena in  $(1-x)\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$ . (x)**

**Ba<sub>0.85</sub>Ca<sub>0.15</sub>Ti<sub>0.90</sub>Zr<sub>0.10</sub>O<sub>3</sub> Solid Solutions Using In-situ Temperature Dependent Raman Spectroscopy**, **Koyal Suman Samantaray**, Maneesha P, Indranil Bhawmik, and Somaditya Sen\*. <https://doi.org/10.1088/1361-648X/ad475e>.

- **Composition and Electric field driven studies on the modified NBT-based lead-free ceramics**, **Koyal Suman Samantaray**, Maneesha P, Rakhi Saha, K Harrabi, A Mekki, and Somaditya Sen\*. *Materials Science and Engineering B*, 300 (2024), 117140. <https://doi.org/10.1016/j.mseb.2023.117140>.

#### **Apart from Thesis:**

- **Effect of poling on the structural, vibrational, and electrical properties of Na<sub>0.47</sub>Bi<sub>0.47</sub>Ca<sub>0.06-x</sub>Ba<sub>x</sub>TiO<sub>3</sub> lead-free ceramics**, **Koyal Suman Samantaray**, Ruhul Amin, Maneesha P, Indranil Bhaumik, and Somaditya Sen\*. *Ceramics International*, Volume 49, Issue 9, Part A, 1 May 2023, Pages 14310-14326, <https://doi.org/10.1016/j.ceramint.2023.01.018>.
- **Room Temperature Magneto-dielectric coupling in the CaMnO<sub>3</sub> modified NBT lead-free ceramics**, **Koyal Suman Samantaray**, Ruhul Amin, Saniya Ayaz, A. K. Pathak, Christopher Hanley, A. Mekki, K. Harrabi, Somaditya Sen\*. *Applied Physics A volume 129*, Article number: 237 (2023), <https://doi.org/10.1007/s00339-023-06513-4>.
- **Defect Dipole Induced Electrocaloric Effect in modified NBT-6BT Ceramics**, **KS Samantaray**, R Amin, EG Rini, I Bhaumik, A Mekki, K Harrabi, S Sen\*, *Journal of Alloys and Compounds* 903, (2022), 163837, <https://doi.org/10.1016/j.jallcom.2022.163837>
- **Fe-doped Na<sub>0.47</sub>Bi<sub>0.47</sub>Ba<sub>0.06</sub>Ti<sub>0.98-x</sub>V<sub>0.02</sub>Fe<sub>x</sub>O<sub>3</sub>: Structure correlated vibrational, optical, and electrical properties**, **Koyal Suman Samantaray**, Ruhul Amin, E.G. Rini, Somaditya Sen\*, *Journal of Alloys and Compounds* 848 (2020) 156503, <https://doi.org/10.1016/j.jallcom.2020.156503>.
- **Hydrothermal Synthesis of CuWO<sub>4</sub>-Reduced Graphene Oxide Hybrids and Supercapacitor Application**, **Koyal Suman Samantaray**, Surjit Sahoo and Chandra Sekhar Rout\*, *American Journal of Engineering and Applied Sciences*, 9(3), 584-590.

#### **CO-AUTHORS:**

- **Compositional induced structural phase transitions in (1 - x)(K<sub>0.5</sub>Na<sub>0.5</sub>)NbO<sub>3</sub>-x(Ba<sub>0.5</sub>Sr<sub>0.5</sub>)TiO<sub>3</sub> ferroelectric solid solutions**, Satyaranjan Sahoo, Dhiren K. Pradhan, Shalini Kumari, **Koyal Suman Samantaray**, Charanjeet Singh, Anupam Mishra, Md. Mijanur Rahaman, Banarji Behera, Ashok Kumar Reji Thomas, Philip D. Rack & Dillip K. Pradhan\*. *Scientific Reports*, (2023) 13:19096 | <https://doi.org/10.1038/s41598-023-45713-z>.
- **Effect of oxygen vacancies and cationic valence state on multiferroicity and magnetodielectric coupling in (1-x)BaTiO<sub>3</sub>.(x)LaFeO<sub>3</sub> solid solution**, P. Maneesha, **Koyal Suman Samantaray**, Suresh Chandra Baral, Grace Brzykcy, Indranil Bhaumik, Abdelkrim Mekki, Arjun K Pathak, Somaditya Sen\*. *Journal of Alloys and Compounds*, DOI: 10.1016/j.jallcom.2023.172587.
- **Room Temperature Multiferroicity with enhanced ferroelectric and ferromagnetic properties in Ba<sub>0.75</sub>Pb<sub>0.25</sub>Ti<sub>1-x</sub>Fe<sub>x</sub>O<sub>3</sub>**, Ruhul Amin, **Koyal Suman Samantaray**, Saniya Ayaz, Sachindra N. Sarangi, Indranil Bhaumik, Somaditya Sen\*, *Journal of Alloys and Compounds* 897, (2022), 162734, <https://doi.org/10.1016/j.jallcom.2021.162734>.
- **Tunable ultraviolet sensing performance of Al-modified ZnO nanoparticles**, Saniya Ayaz, Ruhul Amin, **Koyal Samantray**, Arup Dasgupta, Somaditya Sen\*, *Journal of Alloys and Compounds* 884 (2021) 161113, <https://doi.org/10.1016/j.jallcom.2021.161113>.
- **Grain and grain boundary contributions to AC conductivity in ferroelectric Ba<sub>0.75</sub>Pb<sub>0.25</sub>Ti<sub>1-x</sub>Zr<sub>x</sub>O<sub>3</sub> ceramics**, Ruhul Amin, **Koyal suman Samantaray**, E.G., Rini, Indranil Bhaumik, SomadityaSen\*, *CeramicsInternational* 47(2021)13118–13128, <https://doi.org/10.1016/j.ceramint.2021.01.176>

- **Electrochemical glucose-sensing characteristics of two-dimensional faceted and non-faceted CuO nanoribbons**, Rakesh K. Sahoo, Arya Das, **Koyal Samantaray**, Saroj K. Singh, Rajaram S. Mane, Heon-Cheol Shin, Je Moon Yun, and Kwang Ho Kim\*, *CrystEngComm*, 2019, 21, 1607, <https://doi.org/10.1039/C8CE02033G>.

#### **CORRESPONDING AUTHOR:**

- **Temperature-dependent Diffuse Reflectance Spectroscopy: A Tool to Probe Phase Transition in NBT-based Ceramics**, A Mekki, Manju Kumari, Tabinda Nabi, K Harrabi, Somaditya Sen\*, and **Koyal Suman Samantaray\***. (Under review in Journal of Optics).

#### **OTHER RESEARCH EXPERIENCES:**

- ❖ **2017-2018:** Master's degree Thesis at NIT, Rourkela, Odisha, India, 769008, Supervisor: Dr. Dillip Kumar Pradhan  
Title: Studies of structural and dielectric properties of Ca-modified BaTiO<sub>3</sub> ceramic.
- ❖ **2016:** Summer Internship at IIT Bhubaneswar, Odisha, India, 752050, Supervisor- Dr. Chandrasekhar Rout, Ramanujan Fellow, Department of Basic Sciences)  
Title: Hydrothermal Synthesis of CuWO<sub>4</sub> and Graphene Reduced CuWO<sub>4</sub> for Supercapacitor Application.
- ❖ **2015:** Summer Internship at CSIR-IMMT, Bhubaneswar, Odisha, India, 751013, Supervisor- Dr. S.K Singh, Department of Advanced Materials Technology, CSIR-IMMT Bhubaneswar  
Title: Electrochemical glucose-sensing characteristics of two-dimensional faceted and non-faceted CuO nanoribbons.

#### **INSTRUMENTS HANDLED**

- X-Ray Diffraction (Bruker D2 Phaser)
- Raman Spectrometer (Horiba made LabRAM HR Evolution)
- Dielectric spectrometer (Newton's 4<sup>th</sup> Ltd. phase-sensitive multimeter)
- Field Emission Scanning Electron Microscope (Supra55 Zeiss)
- Atomic Force Microscope/Piezo Force Microscope (Park Systems)
- PE Loop Tracer (Marine India)
- UV-Vis Spectrometer (Researchgate India)
- RF Sputtering
- Electrospinning
- Sputter Coater, Spin Coater, Muffle and Tube Furnaces

#### **SOFTWARES LEARNED**

- Full Prof Suite (Rietveld Refinement)
- Mercury and VESTA (Visualization of Structure)
- EC-Lab (Impedance Analysis)
- Fityk (Raman Spectra Peak Fitting)
- ImageJ (Grain Size Distribution)
- Gwyddion (AFM analysis)
- XPS Peak 4.1 (XPS analysis)
- Zotero and Endnote (Adding References)
- Origin (Graphs Plotting and Analysis)
- Microsoft Office

## TEACHING EXPERIENCES:

TA DUTIES	Semester & Year	Batch	Subjects
<b>IIT Indore</b>	a. 2021-22, Spring (Offline) b. 2020-21, Spring (Online)  c. 2020-21. Autumn (Online)  d. 2019-20, Spring (Offline)  e. 2019-20. Autumn (Offline)	Btech. First Year, PH-156	a. Centrifugal Force Expt. b. Frank Hertz and Grating Spectrometer experiment. c. Frank Hertz and Centrifugal force expt. d. Electrodynamics Tutorial. e. Frank Hertz and Centrifugal force expt.
<b>Holkar Govt. Autonomous Colleg, Indore</b>	a. 2020-21, Autumn (Online) b. 2020-21, Spring (Online)  c. 2021-22, Autumn (Online)  d. 2021-22, Spring (offline/online) e. 2021-22, Spring (offline) f. 2022-23, 2023-24 (offline)	a. 1 <sup>st</sup> year Msc b. 2 <sup>nd</sup> Year Msc  c. 1 <sup>st</sup> year Msc  d. 1 <sup>st</sup> year Msc  e. 2 <sup>nd</sup> year Bsc f. 2 <sup>nd</sup> year Bsc	a. Introduction to Quantum Mechanics. b. Condensed Matter Physics c. Introduction to Quantum Mechanics. d. Relativistic Quantum Mechanics  e. Electronics Laboratory f. Electronics Laboratory
<b>NPTEL</b>	2021-22, Spring (online)	Open Platform	Solid state physics for undergraduates

## RESEARCH MENTORS:

Dr. Somaditya Sen <a href="mailto:sens@iiti.ac.in">sens@iiti.ac.in</a>	Department of Physics IIT Indore, Madhya Pradesh, India	PhD Thesis supervisor (2019- present)
Dr. Dillip Kumar Pradhan <a href="mailto:dillippradhan@nitrkl.ac.in">dillippradhan@nitrkl.ac.in</a>	Department of Physics and Astronomy, NIT Rourkela, Odisha, India	Master's Thesis Supervisor (2017-2018)
Dr. Chandra Sekhar Rout	School of Basic Sciences, IIT Bhubaneswar, India	Summer Internship Supervisor (2016)
Dr. Saroj Kumar Singh	Advanced Materials Technology, CSIR-IMMT, India	Summer Internship Supervisor (2015)

## REFEREES:

- ❖ **Dr. Somaditya Sen**, Professor, Dept. Of Physics, IIT Indore, India; [sens@iiti.ac.in](mailto:sens@iiti.ac.in), +91-8839799363 (Ph.D. Supervisor)
- ❖ **Dr. Dillip Kumar Pradhan**, Associate Professor, Dept. Of Physics and Astronomy, NIT Rourkela, India; [dillippradhan@nitrkl.ac.in](mailto:dillippradhan@nitrkl.ac.in), +918328923740 (Master's Thesis Supervisor)
- ❖ **Dr. Abdelkarim Mustafa Cherif Mekki**, Associate Professor, Department of Physics King Fahd University of Petroleum & Minerals; [akmekki@kfupm.edu.sa](mailto:akmekki@kfupm.edu.sa), +966568786306 (Collaborator)

## OTHER ACTIVITIES:

- ❖ Demonstrated science experiments for high school students on the “National Science Day” celebration, 2023 (won the first prize).
- ❖ Honoured to be a judge in National Science Day celebration, 2024.

### Declaration:

I solemnly declare that the above information is correct to the best of my knowledge and belief.

