

# Curriculum Vitae

(as on March 2020)

## Dr. Rajan Singh

Assistant Professor

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### Career Objective

To carry out research and teaching in an Institute of International repute.

### Current Position

Assistant Professor in Electronics & Communication Engineering, School of Engineering and Technology, Central University of Rajasthan, Ajmer, India.

### Education

Qualification	Institute	Year	Subject	Score
Ph.D.	CRNTS, IIT Bombay	2009 - 2015	Electronic Properties of Materials (Piezoelectric, Ferroelectric, Dielectric, Ceramics)	NA
M.Tech	MANIT Bhopal	2006 - 2008	Nanotechnology	9.2
B.Tech	U.P.T.U. Lucknow	2001 - 2005	Electronics & Communication	63.36%

**Ph.D Thesis:** "Synthesis and characterization of lead-free potassium sodium niobate ( $K_{0.5}Na_{0.5}NbO_3$ ) based ceramics".

### Brief:

1. Different ceramic processing techniques has been explored (Colloidal Coating and Mechanochemical Activation methods) to overcome the sintering difficulty of KNN-based ceramics and improve their density, microstructure, ferroelectric and piezoelectric properties. Master sintering theory (MSC) has been applied to predict densification behavior and activation energy for sintering of this material.
2. The effect of sintering aids on density, microstructure, piezoelectric and ferroelectric properties of the KNN ceramic has been investigated. Two sintering aids CuO and  $MnO_2$  are used in this study. It is known that both CuO and  $MnO_2$  show variable valencies. Therefore, it is interesting to explore the effect of these aids on structure and properties to enable further development of KNN-based ceramics.
3. KNN and BT have different crystal structure and lattice vibrations. Therefore, the formation of solid solution between KNN and BT form distorted structure and resulted in interesting piezoelectric properties. The structure changed from orthorhombic to tetragonal at  $x \geq 0.04$  BT and secondly, tetragonal to cubic for  $x > 0.1$  BT.

### Postdoctoral Projects

- **Tsinghua University Beijing:** I worked on a project "*Magnetoresistance (MR) of Silicon at low magnetic field and Silicon based logic device*". Our aim is to enhance MR value in Silicon at room temperature at low magnetic fields so that it can compete with high mobility semiconductor (InSb) and magnetic materials (Cr/Fe multilayers) based MR-sensors. My job is to fabricate samples using DC magnetron sputtering and measure their transport properties. Later we used these devices to perform spin-based logic operations.  
Further, I worked on spin-orbit torque (SOT)-based magnetic memristor. In this work we have modified the conventional Hall bar geometry in such a way that the current density in magnetic material is different for different domain walls. Based on this current density difference the magnetic domains will switch gradually from higher current density towards lower current density and gives the  $I-V$  curve that resembles the  $I-V$  characteristics of memristors.
- **IIT Bombay:** Worked on a project "*National Centre for Photovoltaic Research*". My job is to investigate causes that degrades efficiency of solar panels. The survey team will collect samples from different part of India and I will process such samples chemically to investigate the root causes of degradation on solar panel materials such as back sheet polymers (EVA) and encapsulant degradation. I will use analytical tools such

as SEM, EDX, XRD etc. to investigate different type of EVA grades used by different solar panel manufacturers in India.

### Academic Project

**M.Tech. project** (January-June 2008): “Synthesis and Characterization of ZnS:Ag, Nanophosphor”, Department of Physics, MANIT, Bhopal.

- This project was aimed to develop economical and eco-friendly route for the synthesis of ZnS phosphor. The chemical co-precipitation route was adopted to synthesize pure and doped (Ag and Mn) ZnS phosphors and the effect of heat and fluxing agent (NaCl in different concentrations) on the growth of ZnS phosphors were studied.
- The application of these ZnS phosphors doped with Ag has been widely used for cathode-ray tubes, powder electroluminescence and thin-film electroluminescence. Also, ZnS: (Mn, Ag) phosphors is used in display sensors and illumination devices. It can satisfy the requirement for the future display technique developments; such as flat screens, low operating voltage, high resolution etc.

### Professional Experience

Name of the Organization/Institute	Post Head	Duration		Basic pay in the Scale of Pay/Pay band with Grade Pay
		From	To	
IIT Bombay	Research Assistant	01-12-2014	29-05-2015	28000 + HRA (8400) INR
IIT Bombay	Project Research Associate	01-06-2015	26-08-2015	31500 (Consolidated) INR
IIT Bombay	Project Research Scientist	21-09-2015	30-12-2015	42000 (Consolidated) INR
Tsinghua University Beijing	Post-doctoral Fellow	11-01-2016	30-11-2019	12343 RMB per month

### Experimental skills

- Experience in electronic device fabrication and transport properties measurements.
- Thin film deposition (Sputtering and Pulse Laser Deposition).
- Piezoelectric (strain,  $d_{33}$  meter) and ferroelectric (P-E Loop) characterization (aixACCT TF 2000 analyzer).
- Crystal structure determination from X-ray diffractometer using Rietveld method.
- Expertise in NOVOCOTROL Dielectric Broad Band Spectrometer, Impedance and Conductivity measurements and analysis.
- Expertise in Microscopy. Trained to operate Field Emission Gun-Scanning Electron Microscope independently. I operated JEOL FEG-SEM 7600F independently 2 years and able to handle different type of samples e.g. Ceramics, biological samples, metals, electronic devices etc.
- Differential Scanning Calorimetry (DSC), Thermogravimetric analysis (TGA), Raman Spectroscopy, Particle size analyzer (DLS), Transmission Electron Microscopy (TEM), Electron Spin Resonance (ESR).
- Experiences of operating, maintaining and troubleshooting various laboratory equipment's.

### Publications

S. No.	Title of papers, authors names, name of journal, year, vol. no., page no. etc.	Impact Factor	Citations
1	“Thermal stability of NDR-assisted anomalous Hall effect based magnetic device” <b>Rajan Singh</b> , Zhaochu Luo, Ziyao Lu, Awais Saleemi, Chengyue Xiong, Xiaozhong Zhang, <i>Journal of Applied Physics</i> , 2019, <b>125</b> , 203901.	2.328	--
2	“Diode and Inhomogeneity Assisted Extremely Large Magnetoresistance in Silicon” <b>Rajan Singh</b> , Zhaochu Luo, Ziyao Lu, Awais Saleemi, Chengyue Xiong, Xiaozhong Zhang, <i>Applied Physics Letter</i> , 2017, <b>111</b> , 042406.	3.521	2
3	“Synthesis of nano-crystalline potassium sodium niobate ceramic using mechanochemical activation”, <b>Rajan Singh</b> , Pankaj K. Patro, A.R. Kulkarni, C.S.	3.450	18

	Harendranath, <i>Ceramics International</i> , 2014, <b>40</b> , 10641-10647.		
4	“Effect of sintering temperature on composition, microstructure and electrical properties of $K_{0.5}Na_{0.5}NbO_3$ ceramics”, <b>Rajan Singh</b> , A.R. Kulkarni, C.S. Harendranath, <i>Physica B</i> , 2014, <b>434</b> , 139-144.	1.874	14
5	“Structure composition correlation in KNN-BT ceramics - An X-ray diffraction and Raman spectroscopic investigation”, <b>Rajan Singh</b> , Kaustubh Kambale, Ajit R. Kulkarni, C.S. Harendranath, <i>Materials Chemistry and Physics</i> , 2013, <b>138</b> , 905-908.	2.781	25
6	“Emulation of Learning and Memory Behaviors by Memristor Based on Ag Migration on 2D $MoS_2$ Surface”, Siqi Yin, Zhaochu Luo, Qian Li, Chengyue Xiong, Yunlong Liu, <b>Rajan Singh</b> , Fei Zeng, Yi Zhong, and Xiaozhong Zhang, <i>Physica Status Solidi A</i> , 2019, 1900104.	1.606	3
7	“Particle size-dependent zero-field exchange bias in $LaFeO_3$ nanoparticles” Pranat Jain, Sanjay Srivastava, Saurabh Dayal, <b>Rajan Singh</b> , Oroosa Subhoi, <i>Journal of Superconductivity and Novel Magnetism</i> , 2018, <b>31</b> , 529-539.	1.130	4
8	“Large magnetoresistance of amorphous carbon films” Awais Siddique Saleemi, <b>Rajan Singh</b> , Wen Sun, Zhaochu Luo, Xiaozhong Zhang, <i>Carbon</i> , 2017, <b>122</b> , 122-127.	7.466	4
9	“Structure dependent negative and positive magnetoresistance of amorphous carbon films” Awais Siddique Saleemi, Wen Sun, <b>Rajan Singh</b> , Zhaochu Luo, Xiaozhong Zhang, <i>Journal of Applied Physics</i> , 2017, <b>121</b> , 233903.	2.328	5
10	“Effect of Addition of $V_2O_5$ on the Densification, Dielectric and Ferroelectric Behavior of Lead Free Potassium Sodium Niobate Ceramics”, K.R. Kambale, Sameer Shroff, S.P. Butee, <b>Rajan Singh</b> , A.R. Kulkarni, <i>Ferroelectrics</i> , 2017, <b>518</b> , 94-102.	0.697	2
11	“Structure dependent negative magnetoresistance of amorphous carbon thin films”, Awais Siddique Saleemi, <b>Rajan Singh</b> , Zhaochu Luo, Xiaozhong Zhang, <i>Diamond and Related Materials</i> , 2017, <b>72</b> , 108-113.	2.290	6
12	“High temperature phase diagram of pseudo binary $Ba(Zr_{0.2}Ti_{0.8})O_3-(Ba_{0.7}Ca_{0.3})TiO_3$ ceramic system: In situ X-ray diffraction and dielectric studies”, K.P. Chandra, <b>Rajan Singh</b> , A.R. Kulkarni, K. Prasad, <i>Ferroelectrics</i> , 2017, <b>514</b> , 105-113.	0.697	3
13	“Cathodic titania nanotube arrays as anode material for lithium-ion batteries”, Tauseef Anwar, Wang Li, Rizwan Ur Rehman Sagar, Farhat Nosheen, <b>Rajan Singh</b> , Hasnain Mehdi Jafri, Khurram Shehzad, Liang Tongxiang, <i>Journal of Materials Science</i> , 2017, <b>52</b> , 4323-4332.	3.442	5
14	“Angle dependent magnetotransport in transfer-free amorphous carbon thin films”, Awais Siddique Saleemi, Rizwan Ur Rehman Sagar, <b>Rajan Singh</b> , Zhaochu Luo, Xiaozhong Zhang, <i>Journal of Physics D: Applied Physics</i> , 2016, <b>49</b> , 415005.	2.829	11
15	“High temperature phase transition in $(Ba_{0.76}Ca_{0.24})(Zr_{0.04}Ti_{0.96})O_3$ Ceramic”, K.P. Chandra, <b>Rajan Singh</b> , A.R. Kulkarni, K. Prasad, <i>Ferroelectrics</i> , 2016, <b>502</b> , 231-239.	0.697	6
16	“Impedance analysis and dielectric properties of Ce modified bismuth titanate lead free ceramics synthesized using solution combustion route”, Oroosa Subhoi, <b>Rajan Singh</b> , Gobburu S. Kumar, Mohammad M. Malik, Rajnish Kurchania, <i>Journal of Materials Science: Materials in Electronics</i> , 2015, <b>26</b> , 9122-9133.	2.195	12
17	“Dielectric relaxation in 0-3 PVDF- $Ba(Fe_{1/2}Nb_{1/2})O_3$ composites”, K.P. Chandra, <b>Rajan Singh</b> , A.R. Kulkarni, K. Prasad, <i>AIP Conference Proceeding</i> , 2016, <b>1728</b> , 020638.	--	1
18	“Estimation of the Activation Energy of Sintering in KNN Ceramics using Master Sintering Theory”, <b>Rajan Singh</b> , P.K. Patro, Ajit R. Kulkarni, C.S. Harendranath, <i>AIP Conference Proceeding</i> , 2014, <b>1591</b> , 655.	--	--
19	“Dielectric and piezoelectric properties of KNN synthesized using colloidal coating approach”, <b>Rajan Singh</b> , Ajit R. Kulkarni, C.S. Harendranath, <i>AIP Conference Proceeding</i> , 2013, <b>512</b> , 514.	--	2

### Conference presentations

1. K.R. Kambale, Sameer Shroff, S.P. Butee, **Rajan Singh**, A.R. Kulkarni, "Effect of Addition of  $V_2O_5$  on the Densification, Dielectric and Ferroelectric Behavior of Lead-Free Potassium Sodium Niobate Ceramics" International Conference on Technologically Advanced Materials & Asian Meeting on Electroceramics (ICTAM-AMF10), 7<sup>th</sup> to 11<sup>th</sup> November, 2016, Delhi University, New Delhi, India. (**Poster Presentation**)
2. **Rajan Singh**, Ajit R. Kulkarni and R.P.R. Aiyar, "Occurrence of hardening and softening behavior in  $MnO_2$  doped KNN ceramics" National Conference on Functional Glasses/Glass-Ceramics and Ceramics, (NCFG-2015), 10<sup>th</sup> to 12<sup>th</sup> December, 2015, V.N.I.T. Nagpur, India. (**Oral Presentation**)
3. **Rajan Singh**, Ajit R. Kulkarni and R.P.R. Aiyar, "Electrical properties of  $MnO_2$  doped KNN ceramics" 3<sup>rd</sup> In-House Meet of Nanotechnology & Science, (IMNANO-2015), 21<sup>st</sup> March, 2015, I.I.T. Bombay, Mumbai, India. (**Oral Presentation**)
4. **Rajan Singh**, P.K. Patro, Ajit R. Kulkarni and C.S. Harendranath, "Synthesis of KNN nano-ceramic using high

*energy ball milling*" National Conference on "Nanomaterials: The Indian Perspective", 22<sup>nd</sup> January, 2015, Maharshi Dayanand Collage of Arts, Science and Commerce, Mumbai, India. **(Oral Presentation)**

5. **Rajan Singh**, Ajit R. Kulkarni and R.P.R. Aiyar, "*Occurrence of hardening and softening behavior in MnO<sub>2</sub> doped KNN ceramics*" 9<sup>th</sup> Asian Meeting on Ferroelectrics and the 9<sup>th</sup> Asian Meeting on Electroceramics (AMF-AMEC-2014) joint conference, 26<sup>th</sup> to 30<sup>th</sup> October, 2014, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China. **(Oral Presentation)**
6. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Impedance and conductivity studies of CuO modified KNN ceramics*" 2<sup>nd</sup> In-House Meet of Nanotechnology & Science, (IMNANO-2014), 10<sup>th</sup> May, 2014, I.I.T. Bombay, Mumbai, India. **(Oral Presentation)**
7. **Rajan Singh**, P.K. Patro, Ajit R. Kulkarni and C.S. Harendranath, "*Estimation of the Activation Energy of Sintering in KNN Ceramics using Master Sintering Theory*" 58<sup>th</sup> DAE Solid State Physics Symposium, 17<sup>th</sup> to 21<sup>st</sup> December, 2013, Thapar University, Patiala, India. **(Poster Presentation)**
8. **Rajan Singh**, P.K. Patro, Ajit R. Kulkarni and C.S. Harendranath, "*Synthesis of Nano-crystalline Potassium Sodium Niobate Ceramic using Mechanochemical Activation*" International Conference on Nanoscience & Nanotechnology (ICNN), 18<sup>th</sup> to 20<sup>th</sup> November, 2013, B.B.A. University, Lucknow, India. **(Oral Presentation)**
9. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Dielectric and piezoelectric properties of KNN synthesized using colloidal coating approach*" 57<sup>th</sup> DAE Solid State Physics Symposium, 3<sup>rd</sup> to 7<sup>th</sup> December, 2012, IIT Bombay, Mumbai, India. **(Poster Presentation)**
10. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Effect of sintering aids on structure, morphology and electrical properties of KNN ceramics*" 1<sup>st</sup> In-House Meet of Nanotechnology & Science, (IMNANO-2012), 1<sup>st</sup> September, 2012, I.I.T. Bombay, Mumbai, India. **(Poster Presentation)**
11. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Structure composition correlation in KNN-BT ceramics - An X-ray diffraction and Raman spectroscopic investigation*" The 8th Asian meeting on Electroceramics (AMEC-8), 1<sup>st</sup> to 5<sup>th</sup> July, 2012, University Sains Malaysia, Penang, Malaysia. **(Oral Presentation)**
12. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Phase characteristics and electrical properties of (1-x)KNN-(x)BT ceramics*" International Conference and Workshop on Nanostructured Ceramics and other Nanomaterials (ICWNCN), 13<sup>th</sup> to 16<sup>th</sup> March, 2012, Delhi University, New Delhi, India. **(Poster Presentation)**
13. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Synthesis and Characterization of Lead Free Ferroelectric K<sub>0.5</sub>Nb<sub>0.5</sub>NbO<sub>3</sub> Ceramic by Solution Coating Method*" National Seminar on Ferroelectrics and Dielectrics (NSFD-XVI), 2<sup>nd</sup> to 4<sup>th</sup> December, 2010, G.G. University, Bilaspur, India. **(Oral Presentation)**
14. **Rajan Singh**, Ajit R. Kulkarni and C.S. Harendranath, "*Synthesis and Dielectric behavior of Lead free KNN Ceramics*" International Conference on Electroceramics (ICE), 13<sup>th</sup> to 17<sup>th</sup> December, 2009, Delhi University, New Delhi, India. **(Poster Presentation)**
15. **Rajan Singh**, Shreyas Pitale and R.N. Dubey, "*Synthesis and Characterization of Nano-crystalline ZnS: (Ag, Mn) Nano-phospher*" National Seminar on Recent Trends in Luminescence (NSRTL-2008), 26<sup>th</sup> April, 2008, R.D. University, Jabalpur, India. **(Poster Presentation)**

#### Computer skills

**Operating Systems:** Windows

**Application Software:** MS Office, Reference manager, Adobe

**Analysis software:** Winfit, EIS, ZSimpWin, Fullprof, Origin, Wincell, Comsol, L-Edit, S-Edit

**Design software:** Diamond, Photoshop, Edraw max

#### Achievements

- Qualified Graduate Aptitude Test in Engineering (**GATE-2006**) in Electronics and Communication.
- Got MHRD fellowship for pursuing Ph.D.
- Awarded, DST-International Travel Grant to present my research work in 9<sup>th</sup> Asian Meeting on Ferroelectrics and the 9<sup>th</sup> Asian Meeting on Electroceramics (AMF-AMEC-2014) held in Shanghai, China.
- Awarded, Dr. D.S. Kothari Postdoctoral Fellowship from UGC in 2015 (did not joined).
- Got best oral presentation in "National Conference on Functional Glasses/Glass-Ceramics and Ceramics, (NCFG-2015)" organized by V.N.I.T. Nagpur.

#### Professional References

1. **Prof. Ajit R. Kulkarni**, Department of Metallurgical Engineering & Materials Science, IIT Bombay, India, Email: ajit.kulkarni@iitb.ac.in, Phone: +91-22-2576-7636.
2. **Dr. Pankaj Kumar Patro**, Composite Materials Section, Powder Metallurgy Division, Materials Group, BARC, Vashi Complex, Navi Mumbai, India, Email: pkpatro@barc.gov.in, Phone: +91-22-2788-7144.
3. **Prof. Parsh H. Salame**, Institute of Chemical Technology, Matunga, Mumbai, India, Email: ph.salame@ictmumbai.edu.cn, Phon: +91-22-3361-2661