




# Prof. Binay Kumar

Crystal Lab, Department of Physics & Astrophysics,  
University of Delhi, Delhi-110007 (INDIA)



Title	<b>DR.</b>	First Name	<b>BINAY</b>	Last Name	<b>KUMAR</b>	Photograph
Designation		<b>Professor</b>				
Department		<b>Physics &amp; Astrophysics</b>				
Address (Campus)		<b>Crystal Lab, Department of Physics &amp; Astrophysics, University of Delhi, Delhi-110007</b>				
(Residence)		<b>D-19, 29/31 Probyn Road (Chattra Marg), University of Delhi, Delhi-110007</b>				
Phone No (Campus)		<b>+91-11-27662289</b>				
(Residence) <small>optional</small>		<b>+91-11-27662026</b>				
Mobile						
Fax		<b>+91-11-27667061 (HOD)</b>				
Email		<a href="mailto:bkumar@physics.du.ac.in">bkumar@physics.du.ac.in</a> , <a href="mailto:b3kumar69@gmail.com">b3kumar69@gmail.com</a> <a href="mailto:b3kumar69@yahoo.co.in">b3kumar69@yahoo.co.in</a>				
Web-Page		<a href="https://scholar.google.co.in/citations?user=m8RVxaYAAAAJ&amp;hl=en">https://scholar.google.co.in/citations?user=m8RVxaYAAAAJ&amp;hl=en</a>				

Education			
Subject	Institution	Year	Details
<b>Ph. D.</b>	<b>University of Delhi</b>	<b>1992</b>	<b>Thesis topic: Polytypism of vapour grown dendritic single crystals of both undoped and doped cadmium iodide</b>
<b>M. Sc.</b>	<b>Bhagalpur University</b>	<b>1986</b>	<b>Subjects: Physics</b>
<b>B. Sc. (Hons)</b>	<b>Bhagalpur University</b>	<b>1983</b>	<b>Subjects: Physics (Hons), Chemistry, Maths.</b>

Career Profile			
Organization	Designation	Duration	Role
<b>University of Delhi</b>	<b>Professor</b>	<b>Since 1 Jan 2009 Till Date</b>	<b>Teaching &amp; Research</b>
<b>University of Delhi</b>	<b>Associate Professor</b>	<b>1 Jan 2006-31 Dec 2008</b>	<b>Teaching &amp; Research</b>
<b>University of Delhi</b>	<b>Reader</b>	<b>June 2001 - 31 Dec 2005</b>	<b>Teaching &amp; Research</b>
<b>University of Delhi</b>	<b>Lecturer (&amp; Senior Lecturer)</b>	<b>Jan 1993 - June 2001</b>	<b>Teaching &amp; Research</b>
<b>University of Delhi</b>	<b>Research Associate</b>	<b>Aug.1992 - Jan 1993</b>	<b>Teaching &amp; Research</b>

**Research Interests / Specialization:** Crystal Growth, Nanoparticles, Ceramic, Piezo-/Ferroelectricity, Characterization, Energy Harvesting, Sensor & Communication Devices  
**Ph.D. Supervised:** 15 (awarded); Under progress: 8  
**Papers Published:** ~150(Citations: ~2700; h-index: 29; i10-index: 80); Talk in Conferences: ~ 50  
**Major Projects:** 6 (DST, DRDO, UGC)  
**Administrative:** Acting Chairman/Member Governing Body, Ram Lal Anand College  
**Visit Abroad:** USA, France, Spain, Singapore

## Research Work of Prof. BINAY KUMAR (01-01-2009 onwards)

Prof. Binay Kumar is the group leader of Crystal Lab in the Department of Physics & Astrophysics, University of Delhi, in which research work for the growth of single crystals of technologically important materials like high performance piezoelectric (e.g. lead based PZN-PT, PMN-PT; lead free BNKT, NKLN; organic TGS;  $\text{LiNbO}_3$ , etc.), high  $T_c$  superconductors (e.g. Bi-2212), ZnO & multiferroic BFO nano structure,  $\text{MX}_2$  compounds, Organic & Semi-organic NLO materials and their characterization are being undertaken. Enhancement of crystallographic and material properties is one of the targets of our research work. Single crystals are grown by flux, solution, vapor, CZ, traveling zone etc. techniques while the characterization include techniques like XRD, SEM, TEM, AFM, TGA, Dielectric, Piezometry ( $d_{33}$ ), Ferroelectric (P-E loop, etc), Pyroelectric, UV-Vis, FTIR etc. .

A diverse range of novel shapes of piezoelectric nanostructures, namely 1D nanopencils, 1D nanotapers, 2D porous nanosheets, 3D hierarchical flower-like architectures made up of nanosils are synthesized. We are now developing the composite of these piezoelectric nanostructures with the flexible polymers, namely PDMS to study the electrical, mechanical and electromechanical response of these individual nanostructures in harvesting the mechanical energy present in the environment.

The synthesized ceramics, nanoparticles and crystals are used to fabricate pressure sensor, energy harvesting (nanogenerators) and communication (patch antenna) devices.

Since 2009, five major projects have been undertaken; thirteen students have completed Ph.D. while nearly 115 papers have been published in Refereed International Journals.

### **Major Facility in Crystal Lab:**

Crystal Growth: Czochralski and Modified CZ set up, Furnaces for Flux growth (Nabertherm and Heraeus), Zone Refining set up, CTB, Ball Mill, Centrifuge, Autoclave

Characterization: Ferroelectric/ Piezoelectric/ Pyroelectric set up (Radiant and Marine), Dielectric, Piezometer (Piezotest PM300), Microhardness, I-V/Hall measurement, Particle size analyzer, Force simulator, DSO, Pelletizer

**LIST OF PUBLICATIONS OF PROF. BINAY KUMAR  
(01 January 2009 to 28 February 2019; Past 10 years)**

In Indexed/ Peer Reviewed Journals

<b>Year</b>	<b>Title</b>	<b>Journal</b>	<b>Author</b>
<b>118 (2019)</b>	Y <sup>3+</sup> doped 0.64PMN-0.36PT ceramic for energy scavenging applications: Excellent piezo-/ferro-response with the investigations of true-remanent polarization and resistive leakage	Journal of Alloys and Compounds (2019) ISSN: 0925-8388 IF: 3.779 <a href="https://doi.org/10.1016/j.jallcom.2019.03.144">10.1016/j.jallcom.2019.03.144</a>	Abid Hussain, Nidhi Sinha, Sahil Goel, Abhilash J. Joseph, & Binay Kumar
<b>117 (2019)</b>	"Flexible lead-free piezo-/ferroelectric Bi <sub>0.5</sub> (Na <sub>0.6</sub> K <sub>0.4</sub> ) <sub>0.5</sub> TiO <sub>3</sub> ceramic incorporated PDMS polymer composites for energy harvesting application"	Journal of Materials Science: Materials in Electronics (2019) ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-019-00917-w">10.1007/s10854-019-00917-w</a>	Kriti Batra, Nidhi Sinha & Binay Kumar
<b>116 (2019)</b>	On the prediction of external shape of ZnO nanocrystals	Physica E: Low-dimensional Systems and Nanostructures 106 (2019) 291–297 ISSN: 1386-9477 IF: 2.399 <a href="https://doi.org/10.1016/j.physe.2018.08.014">10.1016/j.physe.2018.08.014</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, & Binay Kumar
<b>115 (2019)</b>	Anisotropic electrical and optical studies of organic Biphenyl single crystal grown by modified Czochralski technique	Journal of Materials Science: Materials in Electronics 30 (2018) 3909–3920 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-019-00676-8">10.1007/s10854-019-00676-8</a>	Sumit Bhukkal, Nidhi Sinha, Sonu Kumar & Binay Kumar
<b>114 (2019)</b>	True-remanent, resistive-leakage and mechanical studies of flux grown 0.64PMN-0.36PT single crystals	Arabian Journal of Chemistry (2019) ISSN: 1878-5352 IF: 4.553 <a href="https://doi.org/10.1016/j.arabjc.2018.06.012">10.1016/j.arabjc.2018.06.012</a>	Abhilash J. Joseph, Nidhi Sinha, Sahil Goel, Abid Hussain & Binay Kumar
<b>113 (2019)</b>	Growth of pure and BFO doped KCl crystals by Czochralski technique and fabrication of microstrip patch antenna for GHz applications	Journal of Materials Science: Materials in Electronics 30 (2019) 2118-2126 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-018-0483-1">10.1007/s10854-018-0483-1</a>	Sonu Kumar, Nidhi Sinha, Sumit Bhukkal, & Binay Kumar

<b>112 (2018)</b>	Ferroelectric Sb-doped PMN-PT crystal: high electromechanical response with true-remanent polarization and resistive leakage analyses	Journal of Materials Science: Materials in Electronics 29 (2018) 19567–19577 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-018-0088-8">10.1007/s10854-018-0088-8</a>	Abid Hussain, Nidhi Sinha, Abhilash J. Joseph, Sahil Goel & Binay Kumar
<b>111 (2018)</b>	Intrinsic polarization and resistive leakage analyses in high performance piezo-/pyroelectric Ho-doped 0.64PMN-0.36PT binary ceramic	Advanced Powder Technology 29 (2018) 3124–3137 ISSN: 0921-8831 I.F. 2.943 <a href="https://doi.org/10.1016/j.appt.2018.08.012">10.1016/j.appt.2018.08.012</a>	Abid Hussain & Binay Kumar
<b>110 (2018)</b>	Di-/piezo-/ferro-electric characterizations of 3D hierarchical sisal-like Eu <sup>3+</sup> /Gd <sup>3+</sup> co-doped ZnO microflowers assembled with 1D nanopencils	Ionics (2018) ISSN: 1862-0760 I.F. 2.347 <a href="https://doi.org/10.1007/s11581-018-2721-1">10.1007/s11581-018-2721-1</a>	Sahil Goel, Nidhi Sinha, Abid Hussain, Abhilash J. Joseph, & Binay Kumar
<b>109 (2018)</b>	3D hierarchical Ho-doped ZnO microflowers assembled with nanosheets: A high temperature ferroelectric material	Physica E: Low-dimensional Systems and Nanostructures 105 (2019) 29–40 ISSN: 1386-9477 I.F. 2.399 <a href="https://doi.org/10.1016/j.physe.2018.09.002">10.1016/j.physe.2018.09.002</a>	Sahil Goel, Nidhi Sinha, & Binay Kumar
<b>108 (2018)</b>	Enhanced dielectric, ferroelectric and piezoelectric performance of Nd-ZnO nanorods and their application in flexible piezoelectric nanogenerator	Journal of Alloys and Compounds 767 (2018) 1003-1011 ISSN: 0925-8388 IF: 3.779 <a href="https://doi.org/10.1016/j.jallcom.2018.07.187">10.1016/j.jallcom.2018.07.187</a>	Kriti Batra, Nidhi Sinha, Sahil Goel, Harsh Yadav, Abhilash Joseph & Binay Kumar
<b>107 (2018)</b>	0.37BF-0.31PMN-0.32PT: A superior piezo-/pyro-/ferro-electric ternary ceramic at MPB	Ceramics International 44 (2018) 18633–18640 ISSN: 0272-8842 IF: 3.057 <a href="https://doi.org/10.1016/j.ceramint.2018.07.089">10.1016/j.ceramint.2018.07.089</a>	Abhilash J. Joseph, Nidhi Sinha, Sahil Goel, Abid Hussain & Binay Kumar
<b>106 (2018)</b>	2D porous nanosheets of Y-doped ZnO for dielectric and ferroelectric applications	Journal of Materials Science: Materials in Electronics 29 (2018) 13818–13832 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-018-9513-2">10.1007/s10854-018-9513-2</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, Abhilash J. Joseph & Binay Kumar
<b>105 (2018)</b>	Sunset yellow dyed triglycine sulfate single crystals: enhanced thermal, mechanical, optical and di-/piezo-/ferro-/pyro-electric properties	Journal of Materials Science: Materials in Electronics 29 (2018) 13449–13463 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-018-9470-9">10.1007/s10854-018-9470-9</a>	Sahil Goel, Nidhi Sinha, Abid Hussain, Abhilash J. Joseph, Harsh Yadav & Binay Kumar

<b>104 (2018)</b>	Reply to comment on the paper “Remarkable enhancement in dielectric, piezoelectric, ferroelectric and SHG properties by iron doping in sodium para-nitrophenolatedihydrate single crystal” [Mater. Lett. 165 (2016) 99–102]	Materials Letters 218 (2018) 360-363 ISSN: 0167-577X IF: 2.687 <a href="https://doi.org/10.1016/j.matlet.2018.02.005">10.1016/j.matlet.2018.02.005</a>	Binay Kumar
<b>103 (2018)</b>	Glycine glutaric acid cocrystals: Morphological, optical, dielectric and mechanical properties via nanoindentation	Vacuum 154 (2018) 90-100 ISSN: 0042-207X IF: 2.067 <a href="https://doi.org/10.1016/j.vacuum.2018.04.043">10.1016/j.vacuum.2018.04.043</a>	Sumit Bhukkal, Nidhi Sinha, Harsh Yadav, Sahil Goel, Budhendra Singh, Igor Bdikin, & Binay Kumar
<b>102 (2018)</b>	Y-doped ZnO nanosheets: Gigantic piezoelectric response for an ultrasensitive flexible piezoelectric nanogenerator	Ceramics International 44 (2018) 8582–8590 ISSN: 0272-8842 IF: 3.057 <a href="https://doi.org/10.1016/j.ceramint.2018.02.066">10.1016/j.ceramint.2018.02.066</a>	Nidhi Sinha, Sahil Goel, Abhilash J. Joseph, Harsh Yadav, Kriti Batra, Manoj Kumar Gupta, & Binay Kumar
<b>101 (2018)</b>	Mechanical investigations on piezo-/ferroelectric maleic acid-doped triglycine sulphate single crystal using nanoindentation technique	Arabian Journal of Chemistry (2018) ISSN: 1878-5352 Impact Factor: 4.553 <a href="https://doi.org/10.1016/j.arabjc.2018.02.001">10.1016/j.arabjc.2018.02.001</a>	Abid Hussain, Nidhi Sinha, Abhilash J. Joseph, Sahil Goel, Budhendra Singh, Igor Bdikin, & Binay Kumar
<b>100 (2018)</b>	Giant piezoelectric behavior in relaxor ferroelectric environment friendly $\text{Na}_{0.52}\text{K}_{0.44}\text{Li}_{0.04}\text{Nb}_{0.84}\text{Ta}_{0.10}\text{Sb}_{0.06}\text{O}_3$ ceramics for high temperature applications	Journal of Materials Science: Materials in Electronics 29 (2018) 6403–6411 ISSN: 0957-4522 IF: 2.324 <a href="https://doi.org/10.1007/s10854-018-8620-4">10.1007/s10854-018-8620-4</a>	Abid Hussain, Nidhi Sinha, Komal Dhankhar, Abhilash J. Joseph & Binay Kumar
<b>(99) 2017</b>	Study of true-remanent polarization using remanent hysteresis task and resistive leakage analysis in ferroelectric $0.64\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3-0.36\text{PbTiO}_3$ ceramics	Solid State Communications 271 (2018) 11–15 ISSN: 0038-1098 IF: 1.549 <a href="https://doi.org/10.1016/j.ssc.2017.12.017">10.1016/j.ssc.2017.12.017</a>	Abhilash J. Joseph & Binay Kumar
<b>(98) 2017</b>	Growth of an 8-hydroxyquinoline single crystal by a modified Czochralski growth technique, and crystal characterization	CrystEngComm, 20 (2018) 624–630 ISSN: 1466-8033 IF: 3.304 <a href="https://doi.org/10.1039/C7CE01857F">10.1039/C7CE01857F</a>	Sonu Kumar & Binay Kumar

<b>(97) 2017</b>	X-ray, dielectric, piezoelectric and optical analysis of a new NLO 8-hydroxyquinolinium hydrogen squarate crystal	Acta Crystallographica Section B B74 (2018) 12-23 ISSN: 2052-5206 IF: 6.467 <a href="https://doi.org/10.1107/S2052520617013038">10.1107/S2052520617013038</a>	Sahil Goel, Harsh Yadav, Nidhi Sinha, Budhendra Singh, Igor Bdikin & Binay Kumar
<b>(96) 2017</b>	Ferro-/pyroelectric response of 0.57BF-0.31PMN-0.12PT ternary ceramic far away from morphotropic phase boundaries	Ceramics International (2017) 43 (2017) 16676–16683 ISSN: 0272-8842 IF: 2.896 <a href="https://doi.org/10.1016/j.ceramint.2017.09.058">10.1016/j.ceramint.2017.09.058</a>	Abhilash J. Joseph, Sahil Goel, Abid Hussain & Binay Kumar
<b>(95) 2017</b>	An insight into the synthesis, crystal structure, geometrical modelling of crystal morphology, Hirshfeld surface analysis and characterizations of <i>N</i> -(4-methylbenzyl)benzamide single crystal	Journal of Applied Crystallography 50 (2017) 1498-1511 ISSN: 1600-5767 IF: 2.57 <a href="https://doi.org/10.1107/S1600576717012316">10.1107/S1600576717012316</a>	Sahil Goel, Harsh Yadav, Nidhi Sinha, Budhendra Singh, ... & Binay Kumar
<b>(94) 2017</b>	Ferroelectric Gd-doped ZnO nanostructures: enhanced dielectric, ferroelectric and piezoelectric properties	Materials Chemistry and Physics 202 (2017) 56-64 ISSN: 0254-0548 IF: 2.101 <a href="https://doi.org/10.1016/j.matchemphys.2017.08.067">10.1016/j.matchemphys.2017.08.067</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, Sanjay Godara, Abhilash J. Joseph & Binay Kumar
<b>(93) 2017</b>	Improvement in dielectric, piezoelectric and ferroelectric properties of 0.64PMN–0.36PT ceramics by Sb modification	Journal of Materials Science: Materials in Electronics 28 (2017) 14298–14307 ISSN: 0957-4522 IF: 2.019 <a href="https://doi.org/10.1007/s10854-017-7289-4">10.1007/s10854-017-7289-4</a>	Abid Hussain, Nidhi Sinha, Abhilash J Joseph, Komal Dhankhar, Sahil Goel & Binay Kumar
<b>(92) 2017</b>	Experimental investigation on the structural, dielectric, ferroelectric and piezoelectric properties of La doped ZnO nanoparticles and their application in dye-sensitized solar cells	Physica E: Low-Dimensional Systems and Nanostructures 91 (2017) 72–81 ISSN: 1386-9477 IF: 2.221 <a href="https://doi.org/10.1016/j.physe.2017.04.010">10.1016/j.physe.2017.04.010</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, Abhilash J Joseph & Binay Kumar
<b>(91) 2017</b>	Optical, piezoelectric and mechanical properties of xylenol orange doped ADP single crystal for NLO applications	Arabian Journal of Chemistry (2017) DOI:10.1016/j.arabjc.2017.03.003 ISSN: 1878-5352 Impact Factor: 4.553 <a href="https://doi.org/10.1016/j.arabjc.2017.03.003">10.1016/j.arabjc.2017.03.003</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, Abhilash J. Joseph, Abid Hussain & Binay Kumar



<b>(90) 2017</b>	Growth, crystal structure, Hirshfeld surface, optical, piezoelectric, dielectric and mechanical properties of bis(L-asparaginium hydrogensquarate) single crystal	Acta Crystallographica Section B B73 (2017) 347-359. ISSN: 2052-5206 IF: 2.89 <a href="https://doi.org/10.1107/S2052520617002906">10.1107/S2052520617002906</a>	Harsh Yadav, Nidhi Sinha, Sahil Goel, Budhendra Singh, ..... & Binay Kumar
<b>(89) 2017</b>	Enhanced dielectric piezo-/ferro-/electric properties of dye doped sodium acid phthalate crystal	Current Applied Physics 17 (2017) 813-819 ISSN: 1567-1739 IF: 2.144 <a href="https://doi.org/10.1016/j.cap.2017.03.007">10.1016/j.cap.2017.03.007</a>	Geeta Ray, Sonu Kumar, Nidhi Sinha, & Binay Kumar
<b>(88) 2017</b>	Copper-catalyzed aerobic oxidative coupling of o-phenylenediamines with 2-aryl/ heteroarylethylamines: direct access to construct quinoxalines	Organic and Biomolecular Chemistry 15 (2017) 2259-2268 ISSN: 1477-0539 IF: 3.559 <a href="https://doi.org/10.1039/C7OB00122C">10.1039/C7OB00122C</a>	Kovuru Gopalaiah, Anupama Saini, .... Harsh Yadav & Binay Kumar
<b>(87) 2017</b>	Determination of intrinsic polarization for K <sub>2</sub> ZnCl <sub>4</sub> single crystal grown by Czochralski technique for ferroelectric applications	Materials Chemistry and Physics 190 (2017) 120–127 ISSN: 0254-0548 IF: 2.101 <a href="https://doi.org/10.1016/j.matchemphys.2017.01.005">10.1016/j.matchemphys.2017.01.005</a>	Sonu Kumar, Geeta Ray, Nidhi Sinha & Binay Kumar
<b>(86) 2016</b>	Growth, structural and physical properties of diisopropylammonium bromide molecular single crystals	Journal of Applied Crystallography 49 (2016) 2053-2062 ISSN: 1600-5767 IF: 2.57 <a href="https://doi.org/10.1107/S1600576716014552">10.1107/S1600576716014552</a>	Harsh Yadav, Nidhi Sinha, Sahil Goel, Abid Hussain & Binay Kumar
<b>(85) 2016</b>	Eu-doped ZnO nanoparticles for dielectric, ferroelectric and piezoelectric applications	Journal of Alloys and Compounds 689 (2016) 333-341 ISSN: 0925-8388 IF: 3.133 <a href="https://doi.org/10.1016/j.jallcom.2016.07.329">10.1016/j.jallcom.2016.07.329</a>	Harsh Yadav, Nidhi Sinha, Sahil Goel & Binay Kumar
<b>(84) 2016</b>	New geometrical modeling to study the crystal morphology.	Crystal Growth & Design 16 (2016) 4559–4566 ISSN: 1528-7483 IF: 4.425 <a href="https://doi.org/10.1021/acs.cgd.6b00665">10.1021/acs.cgd.6b00665</a>	Harsh Yadav, Nidhi Sinha & Binay Kumar
<b>(83) 2016</b>	Modified low temperature Czochralski growth of xylenol orange doped benzophenone single crystal for fabricating dual band patch antenna.	Journal of Crystal Growth 450 (2016) 74–80 ISSN: 0022-0248 I.F. 1.462 <a href="https://doi.org/10.1016/j.jcrysgro.2016.06.035">10.1016/j.jcrysgro.2016.06.035</a>	Harsh Yadav, Nidhi Sinha & Binay Kumar

<b>(82) 2016</b>	Synthesis of $0.64\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ – $0.36\text{PbTiO}_3$ ceramic near Morphotropic Phase Boundary for high performance piezoelectric, ferroelectric and pyroelectric applications.	Journal of Asian Ceramic Societies 4 (2016) 337–343 ISSN: 2187-0764 <a href="https://doi.org/10.1016/j.jascer.2016.06.004">10.1016/j.jascer.2016.06.004</a>	Abid Hussain, Nidhi Sinha, Sonia Bhandari, Harsh Yadav & Binay Kumar
<b>(81) 2016</b>	Effect of crystal violet dye on the structural, optical, mechanical and piezoelectric properties of ADP single crystal.	Materials Research Bulletin, 83 (2016) 77–87 ISSN: 0025-5408 IF: 2.446 <a href="https://doi.org/10.1016/j.materresbull.2016.05.023">10.1016/j.materresbull.2016.05.023</a>	Sahil Goel, Nidhi Sinha, Harsh Yadav, Abid Hussain & Binay Kumar
<b>(80) 2016</b>	Growth, morphology, structure and characterization of L-histidinium dihydrogen arsenate orthoarsenic acid (LHAS) single crystal.	Acta Crystallographica Section B B72 (2016) 593–601 ISSN: 2052-5206 IF: 2.89 <a href="https://doi.org/10.1107/S2052520616007629">10.1107/S2052520616007629</a>	Nidhi Tyagi, Nidhi Sinha, Harsh Yadav & Binay Kumar
<b>(79) 2016</b>	Growth, structural, dielectric, ferroelectric and mechanical properties of L-prolinium tartrate single crystal.	Journal of Materials Science, 51(2016) 7614-7623 ISSN: 0022-2461 I.F. 2.302 <a href="https://doi.org/10.1007/s10853-016-0040-3">10.1007/s10853-016-0040-3</a>	Sonu Kumar, Nidhi Sinha, Harsh Yadav & Binay Kumar
<b>(78) 2016</b>	Growth, crystal structure, Hirshfeld surface, dielectric and mechanical properties of a new organic single crystal: Bis glycine squarate	RSC Advances 6 (2016) 24565-24576 ISSN: 2046-2069 I.F. 3.289 <a href="https://doi.org/10.1039/C5RA18983G">10.1039/C5RA18983G</a>	Nidhi Tyagi, Nidhi Sinha, Harsh Yadav & Binay Kumar
<b>(77) 2016</b>	Flexible High Performance Lead-Free $\text{Na}_{0.47}\text{K}_{0.47}\text{Li}_{0.06}\text{NbO}_3$ Microcubes-Structures Based Piezoelectric Energy Harvester	ACS Appl. Mater. Interfaces 8 (2016) 1766–1773 ISSN: 1944-8244 IF: 7.145 <a href="https://doi.org/10.1021/acsami.5b09485">10.1021/acsami.5b09485</a>	MK Gupta, Sang-Woo Kim & Binay Kumar
<b>(76) 2016</b>	Growth of NBT–BT single crystals by flux method and their structural, morphological and electrical characterizations	Journal of Crystal Growth 441 (2016) 64–70 ISSN: 0022-0248 I.F. 1.462 <a href="https://doi.org/10.1016/j.jcrysgr.2016.01.024">10.1016/j.jcrysgr.2016.01.024</a>	Sreenadha R. Kanuru, K. Baskar, R. Dhanasekaran, & Binay Kumar
<b>(75) 2016</b>	Remarkable Enhancement in dielectric, piezoelectric, ferroelectric and SHG Properties by iron doping in sodium para-nitrophenolate dihydrate single crystals	Materials Letters 165 (2016) 99–102 ISSN: 0167-577X I.F. 2.572 <a href="https://doi.org/10.1016/j.matlet.2015.11.113">10.1016/j.matlet.2015.11.113</a>	Jyoti Dalal & Binay Kumar



<b>(74) 2016</b>	Enhanced microstructure and electrical properties of Mn-modified $\text{Bi}_{0.5}(\text{Na}_{0.65}\text{K}_{0.35})_{0.5}\text{TiO}_3$ ferroelectric ceramics	Ceramics International 42 (2016) 4274–4284 ISSN: 0272-8842 I.F. 2.896 <a href="https://doi.org/10.1016/j.ceramint.2015.11.104">10.1016/j.ceramint.2015.11.104</a>	Sonia Bhandari, Nidhi Sinha & Binay Kumar
<b>(73) 2015</b>	Influence of metal ion doping on dielectric, ionic conductivity and piezoelectric properties of flux grown KTP crystals.	Int. J. of Applied Engineering Research, 10 (2015) 297-301 ISSN: 0973-4562 <a href="#">Link</a>	M. Rathnakumari, J. Rajeev Gandhi, ... & Binay Kumar
<b>(72) 2015</b>	Bulk crystal growth, optical, mechanical and ferroelectric properties of new semiorganic nonlinear optical and piezoelectric Lithium nitrate monohydrate oxalate single crystal.	Optical Materials 51 (2016) 139–147 ISSN: 0925-3476 I.F. 2.183 <a href="https://doi.org/10.1016/j.optmat.2015.11.033">10.1016/j.optmat.2015.11.033</a>	Jyoti Dalal & Binay Kumar
<b>(71) 2015</b>	Study the influence of Nd and Co/Cr co-substitutions on structural, electrical and magnetic properties of $\text{BiFeO}_3$ nanoparticles.	Ceramics International 42 (2016)1782–1790 ISSN: 0272-8842 I.F. 2.896 <a href="https://doi.org/10.1016/j.ceramint.2015.09.141">10.1016/j.ceramint.2015.09.141</a>	Sanjay Godara, Nidhi Sinha & Binay Kumar
<b>(70) 2015</b>	Enhancement of Optical, Piezoelectric, and Mechanical Properties in Crystal Violet Dye-Doped Benzophenone Crystals Grown by Czochralski Technique.	Crystal Growth and Design 15 (2015) 4908–4917 ISSN: 1528-7483 IF: 4.425 <a href="https://doi.org/10.1021/acs.cgd.5b00792">10.1021/acs.cgd.5b00792</a>	Harsh Yadav, Nidhi Sinha, Nidhi Tyagi, & Binay Kumar
<b>(69) 2015</b>	Performance of crystal violet doped triglycine sulfate single crystals for optical and communication applications	CrystEngComm, 17 (2015) 5757–5767 ISSN: 1466-8033 IF: 3.849 <a href="https://doi.org/10.1039/C5CE00703H">10.1039/C5CE00703H</a>	Nidhi Sinha, S. Bhandari, H. Yadav, ..... & Binay Kumar
<b>(68) 2015</b>	Structural, electrical, ferroelectric and mechanical properties with Hirshfeld surface analysis of novel NLO semiorganic sodium p-nitrophenolate dihydrate piezoelectric single crystal	RSC Advances 5 (2015) 57735 - 57748 ISSN: 2046-2069 IF: 3.289 <a href="https://doi.org/10.1039/C5RA10501C">10.1039/C5RA10501C</a>	Jyoti Dalal, Nidhi Sinha, Harsh Yadav & Binay Kumar
<b>(67) 2015</b>	Enhancement in semiconducting and optical properties in doped anthracene micro crystals	Physica B: Condensed Matter 470-471 (2015) 15–20 ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2015.05.001">10.1016/j.physb.2015.05.001</a>	Nidhi Sinha, G. Ray , S. Godara, H. Yadav , S. Bhandari & Binay Kumar
<b>(66) 2015</b>	Enhanced dielectric and piezoelectric properties of Ta-doped ferroelectric $0.50(\text{Na}_{0.5}\text{Bi}_{0.5})\text{TiO}_3-0.50(\text{K}_{0.5}\text{Bi}_{0.5})\text{TiO}_3$ lead-free ceramics	Ceramic International 41 (2015) 10237-10242 ISSN: 0272-8842 I.F. 2.896 <a href="https://doi.org/10.1016/j.ceramint.2015.04.134">10.1016/j.ceramint.2015.04.134</a>	Krishan Kumar, Nidhi Sinha, Sonia Bhandari & Binay Kumar

<b>(65) 2015</b>	Achieving high piezoelectricity and fatigue free hysteresis in lead free relaxor ferroelectric ceramic $0.94[\text{Na}_{0.5}\text{K}_{0.5}\text{NbO}_3]-0.06\text{LiSbO}_3$	Materials Chemistry and Physics 159 (2015)107-113 ISSN: 0254-0584 I.F. 2.4 <a href="https://doi.org/10.1016/j.matchemphys.2015.03.059">10.1016/j.matchemphys.2015.03.059</a>	Geeta Ray, Nidhi Sinha, Sonia Bhandari & Binay Kumar
<b>(64) 2015</b>	Effect of Ba–Nb co-doping on the structural, dielectric, magnetic and ferroelectric properties of $\text{BiFeO}_3$ nanoparticles	Ceramic International 41 (2015) 6912-6919 ISSN: 0272-8842 I.F. 2.896 <a href="https://doi.org/10.1016/j.ceramint.2015.01.145">10.1016/j.ceramint.2015.01.145</a>	Sanjay Godara & Binay Kumar
<b>(63) 2015</b>	Lead Free Relaxor Ferroelectric $\text{Na}_{0.47}\text{K}_{0.47}\text{Li}_{0.06}\text{Nb}_{0.94}\text{Sb}_{0.06}\text{O}_3$ Crystals for Opto-Electronic Applications	Crystal Growth and Design 15 (2015) 1852-1860 ISSN: 1528-7483 I.F. 4.425 <a href="https://doi.org/10.1021/cg501891r">10.1021/cg501891r</a>	Geeta Ray, Nidhi Sinha, Budhendra Singh, Igor Bdikin, & Binay Kumar
<b>(62) 2015</b>	Pyroelectric properties and conduction mechanism in solution grown glycine sodium nitrate single crystal	Physica B: Condensed Matter 462 (2015) 18–24 ISSN: 0921-4526 I.F. 1.352 <a href="https://doi.org/10.1016/j.physb.2015.01.005">10.1016/j.physb.2015.01.005</a>	Nidhi Tyagi, Nidhi Sinha, Harsh Yadav & Binay Kumar
<b>(61) 2015</b>	Growth and characterization of new semiorganic nonlinear optical and piezoelectric Lithium sulfate monohydrate oxalate single crystals	Materials Research Bulletin 64 (2015)194–199 ISSN: 0025-5408 I.F. 2.435 <a href="https://doi.org/10.1016/j.materresbull.2014.12.065">10.1016/j.materresbull.2014.12.065</a>	Harsh Yadav, Nidhi Sinha & Binay Kumar
<b>(60) 2015</b>	Effect of structural modification by $\text{MnO}_2$ addition on the electrical properties of lead free flux grown $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{TiO}_3-(\text{K}_{0.5}\text{Bi}_{0.5})\text{TiO}_3$ single crystals	Crystal Growth and Design 15 (2015) 867–874 ISSN: 1528-7483 I.F. 4.425 <a href="https://doi.org/10.1021/cg5016669">10.1021/cg5016669</a>	Sonia Bhandari & Binay Kumar
<b>(59) 2015</b>	Observation of non linear optical and photoluminescence properties in ferroelectric $0.94[\text{Na}_{0.5}\text{K}_{0.5}\text{NbO}_3]-0.06\text{LiNbO}_3$ single crystals	Materials Letters 143 (2015)105–107 ISSN: 0167-577X I.F. 2.572 <a href="https://doi.org/10.1016/j.matlet.2014.12.088">10.1016/j.matlet.2014.12.088</a>	Geeta Ray & Binay Kumar
<b>(58) 2014</b>	Excellent piezo-/pyro-/ferroelectric performance of $\text{Na}_{0.47}\text{K}_{0.47}\text{Li}_{0.06}\text{NbO}_3$ lead free ceramic near polymorphic phase transition.	Scripta Materialia 99 (2015) 77–80 ISSN: 1359-6462 I.F. 3.305 <a href="https://doi.org/10.1016/j.scriptamat.2014.11.033">10.1016/j.scriptamat.2014.11.033</a>	Geeta Ray, Nidhi Sinha, Sonia Bhandari & Binay Kumar

<b>(57) 2014</b>	Growth and characterization of piezoelectric benzil single crystals and its application in microstrip patch antenna	CrystEngComm 16 (2014) 10700-10710 ISSN: 1466-8033 I.F. 3.849 <a href="https://doi.org/10.1039/C4CE01846J">10.1039/C4CE01846J</a>	Harsh Yadav, Nidhi Sinha & Binay Kumar
<b>(56) 2014</b>	Enhanced electric and magnetic properties in Ce-Cr co-doped Bismuth ferrite nanostructure	Materials Letters 136 (2014) 441-444 ISSN: 0167-577X I.F. 2.572 <a href="https://doi.org/10.1016/j.matlet.2014.08.104">10.1016/j.matlet.2014.08.104</a>	Sanjay Godara, Nidhi Sinha & Binay Kumar
<b>(55) 2014</b>	Combined structural, electrical, magnetic and optical characterization of bismuth ferrite nanoparticles synthesized by auto-combustion route	J Asian Ceramic Society 2 (2014) 416-421 ISSN: 2187-0764 <a href="https://doi.org/10.1016/j.jascer.2014.09.001">10.1016/j.jascer.2014.09.001</a>	Sanjay Godara, Nidhi Sinha, Geeta Ray & Binay Kumar
<b>(54) 2014</b>	Flux growth and effect of cobalt doping on dielectric, conductivity and relaxation behaviour of $0.91\text{Pb}[\text{Zn}_{1/3}\text{Nb}_{2/3}]\text{O}_3-0.09\text{PbTiO}_3$ crystals	CrystEngComm 16 (2014) 9135-42 ISSN: 1466-8033 I.F. 3.849 <a href="https://doi.org/10.1039/C4CE01105H">10.1039/C4CE01105H</a>	B.K. Singh, Igor Bdikin, Ajay Kaushal & Binay Kumar
<b>(53) 2014</b>	$\text{Au}^{9+}$ swift heavy ion irradiation of $\text{Zn}[\text{CS}(\text{NH}_2)_2]_3\text{SO}_4$ crystal: Crystalline perfection and optical properties	Nuclear Instruments and Methods in Physics Research B 338 (2014) 1-7 ISSN: 0168-583X I.F. 1.109 <a href="https://doi.org/10.1016/j.nimb.2014.07.021">10.1016/j.nimb.2014.07.021</a>	S.K. Kushwaha, K.K. Maurya, N. Vijayan, D. Kanjilal & Binay Kumar
<b>(52) 2014</b>	Enhanced piezoelectric output voltage and Ohmic behavior in Cr-doped ZnO nanorods	Materials Research Bulletin 54 (2014)267-271 ISSN: 0025-5408 I.F. 2.435 <a href="https://doi.org/10.1016/j.materresbull.2014.07.032">10.1016/j.materresbull.2014.07.032</a>	Nidhi Sinha, Geeta Ray, Sanjay Godara, Manoj K. Gupta & Binay Kumar
<b>(51) 2014</b>	Structural, Optical and Dielectric studies of novel non-linear Bisglycine Lithium Nitrate piezoelectric single crystal	Optical Materials 37 (2014) 457-63 ISSN: 0925-3467 I.F. 2.183 <a href="https://doi.org/10.1016/j.optmat.2014.07.006">10.1016/j.optmat.2014.07.006</a>	Jyoti Dalal, Nidhi Sinha & Binay Kumar
<b>(50) 2014</b>	Processing and properties of ferroelectric $\text{Bi}_{0.5}(\text{Na}_{0.65}\text{K}_{0.35})_{0.5}\text{TiO}_3$ ceramics under the effect of different sintering temperature	Scripta Materialia 89 (2014) 61-64 ISSN: 1359-6462 I.F. 3.305 <a href="https://doi.org/10.1016/j.scriptamat.2014.06.029">10.1016/j.scriptamat.2014.06.029</a>	Sonia Bhandari, Nidhi Sinha, Geeta Ray & Binay Kumar

<b>(49) 2014</b>	Flux growth of 0.94[Na <sub>0.5</sub> K <sub>0.5</sub> NbO <sub>3</sub> ]-0.06LiNbO <sub>3</sub> piezo-/ferroelectric crystals for long duration and high temperature applications	CrystEngComm, 16 (2014) 7004– 7012 ISSN: 1466-8033 I.F. 3.849 <a href="https://doi.org/10.1039/C4CE00819G">10.1039/C4CE00819G</a>	Geeta Ray, Nidhi Sinha, Sonia Bhandari, B. K. Singh, ..... & Binay Kumar
<b>(48) 2014</b>	Synthesis and enhanced properties of Cerium doped ZnO nanorods.	Ceramic International 40 (2014) 12337–12342 ISSN: 0272-8842 I.F. 2.758 <a href="https://doi.org/10.1016/j.ceramint.2014.04.079">10.1016/j.ceramint.2014.04.079</a>	Nidhi Sinha, Geeta Ray, Sonia Bhandari, Sanjay Godara & Binay Kumar
<b>(47) 2014</b>	Flux growth of lead free (Na <sub>0.5</sub> Bi <sub>0.5</sub> )TiO <sub>3</sub> – (K <sub>0.5</sub> Bi <sub>0.5</sub> )TiO <sub>3</sub> ferroelectric single crystals and their characterization.	CrystEngComm, 16 (2014) 4459 – 4466 ISSN: 1466-8033 I.F: 3.849 <a href="https://doi.org/10.1039/C4CE00249K">10.1039/C4CE00249K</a>	Sonia Bhandari, Nidhi Sinha, Geeta Ray & Binay Kumar
<b>(46) 2014</b>	Synthesis and characterization of multiferroic BFO nanoparticles by auto combustion route with various complexing agents.	Int. J. of Chem. Tech Research 6 (2014) 2083 ISSN: 0974-4290 IF: 0.34 <a href="#">Link</a>	Sanjay Godara, Nidhi Sinha and Binay Kumar
<b>(45) 2014</b>	Enhanced optical, dielectric and piezoelectric behaviour in dye doped zinc tris-thioureasulphate (ZTS) single crystals.	Chemical Physics Letters 591 (2014) 10–15 ISSN: 0009-2614 I.F. 1.815 <a href="https://doi.org/10.1016/j.cplett.2013.11.007">10.1016/j.cplett.2013.11.007</a>	Sonia Bhandari, Nidhi Sinha, Geeta Ray & Binay Kumar
<b>(44) 2014</b>	Evidence of Sustained Ferroelectricity in Glycine Sodium Nitrate Single Crystal.	Current Applied Physics 14 (2014) 156-160 ISSN: 1567-1739 I.F. 2.144 <a href="https://doi.org/10.1016/j.cap.2013.11.005">10.1016/j.cap.2013.11.005</a>	Nidhi Tyagi, Nidhi Sinha & Binay Kumar
<b>(43) 2013</b>	Environment friendly novel piezoelectric 0.94 [Na <sub>0.8</sub> K <sub>0.2</sub> NbO <sub>3</sub> ]-0.06 LiNbO <sub>3</sub> ternary ceramic for high temperature dielectric and ferroelectric applications.	Materials Chemistry and Physics 142 (2013) 619-625 ISSN: 0254-0584 IF: 2.101 <a href="https://doi.org/10.1016/j.matchemphys.2013.08.006">10.1016/j.matchemphys.2013.08.006</a>	Geeta Ray, Nidhi Sinha & Binay Kumar
<b>(42) 2013</b>	Effect of rare earth ions on the properties of glycine phosphate single crystals	Journal of Crystal Growth, 362 (2013)343-348 ISSN: 0022-0248 IF: 1.751 <a href="https://doi.org/10.1016/j.jcrysgr.2011.10.031">10.1016/j.jcrysgr.2011.10.031</a>	K. Senthil kumar, S. Moorthy Babu, G. Bhagavannarayan & Binay Kumar

<b>(41) 2013</b>	Influence of Dopants on Vickers Microhardness of Ferroelectric Glycine Phosphite Single Crystals	Proc Indian Natn Sci Acad 79 (2013) 423-426 ISSN: 0073-6600 IF: 0.3 <a href="#">Link</a>	K. Senthil kumar, S. Moorthy Babu & Binay Kumar
<b>(40) 2013</b>	Structural, Dielectric, Piezoelectric and Ferroelectric Characterization of NBT-BT Lead-Free Piezoelectric Ceramics	Materials Science and Engineering B 43 (2013) 012010 ISSN: 0921-5107 IF: 2.331 <a href="https://doi.org/10.1088/1757-899X/43/1/012010">10.1088/1757-899X/43/1/012010</a>	S. Shanmuga Sundari, R. Dhanasekaran & Binay Kumar
<b>(39) 2013</b>	Growth and properties of sodium tetraborate decahydrate single crystals	Materials Research Bulletin 48 (2013) 1632–1636 ISSN: 0025-5408 IF 2.435 <a href="https://doi.org/10.1016/j.materresbull.2013.01.007">10.1016/j.materresbull.2013.01.007</a>	Neeti Goel, Nidhi Sinha & Binay Kumar
<b>(38) 2013</b>	Enhanced Optical, NLO, dielectric and thermal properties of novel sodium hydrogen phthalate single crystals doped with Zinc	Optical Materials 35 (2013) 479–486 ISSN: 0925-3467 IF: 2.183 <a href="https://doi.org/10.1016/j.optmat.2012.10.020">10.1016/j.optmat.2012.10.020</a>	Neeti Goel, Nidhi Sinha & Binay Kumar
<b>(37) 2013</b>	Effect of SHI Irradiation on NBT-BT Ceramics: Transformation of Relaxor Ferroelectric to Ferroelectric Nature	Applied Surface Science 265 (2013) 296-301 ISSN: 0169-4332 IF: 3.15 <a href="https://doi.org/10.1016/j.apsusc.2012.10.199">10.1016/j.apsusc.2012.10.199</a>	S. Shanmuga Sundari, K. Ashokan, R. Dhanasekaran & Binay Kumar
<b>(36) 2012</b>	Remarkable Enhancement in optical and thermal properties of sodium hydrogen phthalate crystals due to Fe <sup>3+</sup> doping	Journal of Crystal Growth 361(2012)44–50 ISSN: 0022-0248 IF: 1.462 <a href="https://doi.org/10.1016/j.jcrysgr.2012.08.044">10.1016/j.jcrysgr.2012.08.044</a>	Neeti Goel & Binay Kumar
<b>(35) 2012</b>	Improvement in Structural, Dielectric, Ferroelectric and Mechanical Properties in Metal Ions Doped Glycine Phosphite Single Crystals	Ferroelectrics 437 (2012) 126-136 ISSN: 0015-0193 IF: 0.42 <a href="https://doi.org/10.1080/00150193.2012.741992">10.1080/00150193.2012.741992</a>	K. Senthil kumar, Moorthy Babu, G. Bhagavannarayana & Binay Kumar
<b>(34) 2012</b>	Synthesis, dielectric and relaxation behavior of lead free NBT–BT ceramics	Ceramics International 39 (2013) 555–561 ISSN: 0272-8842 IF: 2.896 <a href="https://doi.org/10.1016/j.ceramint.2012.06.063">10.1016/j.ceramint.2012.06.063</a>	S. Shanmuga Sundari, R. Dhanasekaran, & Binay Kumar

<b>(33) 2012</b>	Dielectric studies and band gap tuning of ferroelectric Cr-doped ZnONanorods	Journal of Applied Physics 112 (2012) 014303 ISSN:0021-8979 IF: 2.101 <a href="https://doi.org/10.1063/1.4730933">10.1063/1.4730933</a>	Manoj K. Gupta, Nidhi Sinha & Binay Kumar
<b>(32) 2012</b>	Enhancement in ferroelectric, pyroelectric and photoluminescence properties in dye doped TGS crystals	Journal of Solid State Chemistry 190 (2012) 180-185 ISSN: 0022-4596 IF: 2.265 <a href="https://doi.org/10.1016/j.jssc.2012.02.030">10.1016/j.jssc.2012.02.030</a>	Nidhi Sinha, Neeti Goel, B.K. Singh, M.K. Gupta & Binay Kumar
<b>(31) 2012</b>	Crystalline perfection, Raman, UV-VIS-NIR and prism coupler investigations on Cz-grown pure and Zn-doped LiNbO <sub>3</sub> single crystals	CrystEngComm 14 (2012) 3297 ISSN: 1466-8033 IF: 3.849 <a href="https://doi.org/10.1039/C2CE06710B">10.1039/C2CE06710B</a>	S. K. Kushwaha, K. K. Maurya, N. Vijayan, R. Bhatt, ..... & Binay Kumar
<b>(30) 2012</b>	A comparative study of ferroelectric triglycine sulfate (TGS) crystals grown by conventional slow evaporation and unidirectional method	Materials Research and Bulletin 47 (2012)1587-1597 ISSN: 0025-5408 IF 2.435 <a href="https://doi.org/10.1016/j.materresbull.2012.01.030">10.1016/j.materresbull.2012.01.030</a>	M. Senthil Pandian, P. Ramasamy & Binay Kumar
<b>(29) 2012</b>	Optical and dielectric studies of solution grown glycinium maleate single crystal	Optics Communications 285 (2012) 659–664 ISSN: 0030-4018 IF: 1.588 <a href="https://doi.org/10.1016/j.optcom.2011.11.032">10.1016/j.optcom.2011.11.032</a>	Neelam Singh, B.K. Singh, M.K. Gupta & Binay Kumar
<b>(28) 2012</b>	Effect of Nb-doping on dielectric, ferroelectric and conduction behavior of lead free Bi <sub>0.5</sub> (Na <sub>0.5</sub> K <sub>0.5</sub> ) <sub>0.5</sub> TiO <sub>3</sub> ceramic	Ceramics International 38 (2012) 1157–1165 ISSN: 0272-8842 IF: 2.896 <a href="https://doi.org/10.1016/j.ceramint.2011.08.045">10.1016/j.ceramint.2011.08.045</a>	Krishan Kumar & Binay Kumar
<b>(27) 2011</b>	High T <sub>c</sub> Ferroelectricity in V-Doped ZnO	Journal of Materials Chemistry 21 (2011) 14559-14562 ISSN: 0959-9428 IF: 6.626 <a href="https://doi.org/10.1039/C1JM12107C">10.1039/C1JM12107C</a>	Manoj K. Gupta & Binay Kumar
<b>(26) 2011</b>	Enhancement in dielectric and ferroelectric properties of lead free Bi <sub>0.5</sub> (Na <sub>0.5</sub> K <sub>0.5</sub> ) <sub>0.5</sub> TiO <sub>3</sub> ceramics by Sb-doping	Ceramic International 37 (2011) 2997-3004 ISSN: 0272-8842 IF: 2.758 <a href="https://doi.org/10.1016/j.ceramint.2011.04.013">10.1016/j.ceramint.2011.04.013</a>	Krishan Kumar, B. K. Singh, Manoj K. Gupta, Nidhi Sinha & Binay Kumar
<b>(25) 2011</b>	Effect of zinc chloride on structural, optical and dielectric behavior of solution grown anthracene crystal	Physica B: Condensed Matter 406 (2011) 3206–3209. ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2011.04.073">10.1016/j.physb.2011.04.073</a>	Nidhi Sinha, Manoj K. Gupta , Neeti Goel & Binay Kumar



<b>(24) 2011</b>	p- type K -doped ZnO Nano rods for opto-electronic applications	Journal of Applied Physics 109 (2011) 083532 ISSN:0021-8979 IF: 2.101 <a href="https://doi.org/10.1063/1.3574656">10.1063/1.3574656</a>	Manoj K. Gupta, Nidhi Sinha & Binay Kumar
<b>(23) 2011</b>	Enhanced ferroelectric, dielectric and optical behaviour in Li-doped ZnO nanorods.	Journal of Alloys and Compound 509 (2011) L208–L212 ISSN: 0925-8388 IF: 3.014 <a href="https://doi.org/10.1016/j.jallcom.2011.03.119">10.1016/j.jallcom.2011.03.119</a>	Manoj K. Gupta & Binay Kumar
<b>(22) 2011</b>	Structural, optical and dielectric studies of Glycinium trifluoro acetate single crystal.	Physica B: Condensed Matter 406 (2011) 2152–2157 ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2011.03.020">10.1016/j.physb.2011.03.020</a>	Neelam Singh & Binay Kumar
<b>(21) 2011</b>	Enhancement in crystalline perfection and optical properties of benzophenone single crystals: the remarkable effect of a liquid crystal	J. Appl. Cryst. 44 (2011) 839–845 ISSN: 1600-5767 IF: 2.57 <a href="https://doi.org/10.1107/S0021889811018966">10.1107/S0021889811018966</a>	S. K. Kushwaha, N. Vijayan, K. K. Maurya, A. Kumar, ..... & Binay Kumar
<b>(20) 2011</b>	Investigation of glassy behaviour of flux grown Pb[(Zn <sub>1/3</sub> Nb <sub>2/3</sub> ) <sub>0.91</sub> Ti <sub>0.09</sub> ]O <sub>3</sub> crystal.	Physica B: Condensed Matter 406 (2011) 941–945 ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2010.12.032">10.1016/j.physb.2010.12.032</a>	B.K. Singh & Binay Kumar
<b>(19) 2011</b>	Growth and characterization of new semi organic L-proline strontium chloride monohydrate single crystals.	Physica B: Condensed Matter 406 (2011) 63. ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2010.10.016">10.1016/j.physb.2010.10.016</a>	Manoj K. Gupta, Nidhi Sinha & Binay Kumar
<b>(18) 2011</b>	Studies on the Electrical Properties of Non-linear Optical Allyl Thiourea Cadmium Chloride (ATCB)	AIP Conference Proceedings 1349 (2011) 1055-1056 ISSN: 0094243X <a href="https://doi.org/10.1063/1.3606225">10.1063/1.3606225</a>	Sreekanth G, Michael Augustine, Santhosh kumar, S. Chandralingam,.... & Binay kumar
<b>(17) 2011</b>	Piezoelectric and Mechanical properties of Non-linear Optical Manganese Mercury thiocyanate (MMTC)	AIP Conference Proceedings 1349 (2011) 1289-1290 ISSN: 0094243X <a href="https://doi.org/10.1063/1.3606339">10.1063/1.3606339</a>	Santhosh Kumar, Ignatius Korah, S. Chandralingam,...& Binay kumar
<b>(16) 2010</b>	Structural, Dielectric, Optical and Ferroelectric property of Urea Succinic Acid Crystals grown in aqueous solution containing Maleic Acid	Journal of Physics and Chemistry of Solids 71(2010) 1774–1779. ISSN: 0022-3697 IF: 2.048 <a href="https://doi.org/10.1016/j.jpcs.2010.09.010">10.1016/j.jpcs.2010.09.010</a>	B. K. Singh, Nidhi Sinha, Neelam Singh, Krishna Kumar,.... & Binay Kumar

<b>(15) 2010</b>	Impedance analysis and high temperature conduction mechanism of flux grown $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$ single crystal.	Cryst. Res. Technol. 45 (2010) 1003 – 1011 ISSN: 1521-4079 IF: 1.0 <a href="https://doi.org/10.1002/crat.200900294">10.1002/crat.200900294</a>	B. K. Singh & Binay Kumar
<b>(14) 2010</b>	Effect of electric field on dielectric, ac conduction and ferroelectric behavior of flux-grown $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}\text{O}_3$ single crystals	Physica Status Solidi (A) 207 (2010) 2564-2569 ISSN: 1862-6319 IF: 1.648 <a href="https://doi.org/10.1002/pssa.200925643">10.1002/pssa.200925643</a>	B. K. Singh, K Kumar, Manoj K. Gupta & Binay Kumar
<b>(13) 2010</b>	Synthesis of K-doped p-type ZnO nanorods along (100) for ferroelectric and dielectric applications.	Materials Letters 64 (2010)1825-28 ISSN: 0167-577X IF: 2.572 <a href="https://doi.org/10.1016/j.matlet.2010.05.044">10.1016/j.matlet.2010.05.044</a>	Manoj K. Gupta, Nidhi Sinha, B.K. Singh & Binay Kumar
<b>(12) 2010</b>	Effect of ion irradiation on the M-Nitroaniline single crystals.	Nucl. Instr. and Meth. in Phys. Res. B 268 (2010) 36–41. ISSN No: 0168-583X IF: 1.389 <a href="https://doi.org/10.1016/j.nimb.2009.09.027">10.1016/j.nimb.2009.09.027</a>	T. Kanagasekaran, P. Mythili, R. Gopala -krishnan & Binay Kumar
<b>(11) 2010</b>	Synthesis and Comparative Study of ZnO Nano rods for Structural, Optical and Dielectric Behaviour.	Integrated Ferroelectrics 118 (2010) 61–66 ISSN: 1058-4587 IF: 0.41 <a href="https://doi.org/10.1080/10584587.2010.489478">10.1080/10584587.2010.489478</a>	Manoj K. Gupta, Nidhi Sinha & Binay Kumar
<b>(10) 2010</b>	Organic Ferroelectrics: A Big Surprise.	Nature Asia Materials Research Highlight (2010) ISSN: 1884-4057 IF: 9.1 <a href="https://doi.org/10.1038/asiamat.2010.48">10.1038/asiamat.2010.48</a>	Mohd. Shakir, B.K.Singh, G. Bhagavannarayana, & Binay Kumar
<b>(9) 2010</b>	Synthesis and characterization of Sb-doped $\text{Bi}_{0.5}(\text{Na}_{0.5}\text{K}_{0.5})_{0.5}\text{TiO}_3$ ceramic.	Integrated Ferroelectrics 121 (2010) 99–105 ISSN: 1058-4587 IF: 0.41 <a href="https://doi.org/10.1080/10584587.2010.492025">10.1080/10584587.2010.492025</a>	Krishan Kumar & Binay Kumar
<b>(8) 2010</b>	Growth of <100> directed ADP crystal with slotted ampoule.	Current Applied Physics 10 (2010) 1221-1226. ISSN: 1567-1739 IF: 2.144 <a href="https://doi.org/10.1016/j.cap.2010.02.047">10.1016/j.cap.2010.02.047</a>	P. Rajesh, P. Ramasamy, G. Bhagavannarayana & Binay Kumar

(7) 2010	Effect of cobalt and DL-malic acid on the growth rate, crystalline perfection, optical, mechanical, dielectric, piezoelectric properties and SHG efficiency of ADP single crystals.	Physica B: Condensed Matter B 405 (2010) 2401-06. ISSN: 0921-4526 IF: 1.352 <a href="https://doi.org/10.1016/j.physb.2010.02.054">10.1016/j.physb.2010.02.054</a>	P. Rajesh, P. Ramasamy, G. Bhagavannarayana & Binay Kumar
(6) 2009	Dielectric behaviour and ac electrical conductivity analysis of ZnSe chalcogenide nanoparticles	Chalcogenide Letters 6 (2009) 655-660 ISSN: 1584-8663 IF: 0.7	Mohd. Shakir, B.K. Singh, R.K. Gaur, M.A. Wahab, ..... & Binay Kumar
(5) 2009	Ferroelectricity in glycine picrate: An astonishing observation in a centrosymmetric crystal	Applied Physics Letters 95 (2009) 252902:1-3 IF: 3.411 <a href="https://doi.org/10.1063/1.3275714">10.1063/1.3275714</a>	Mohd. Shakir, B. K. Singh, G. Bhagavannarayana, & Binay Kumar
(4) 2009	Piezoelectric, dielectric, optical and electrical characterization of solution grown flower-like ZnO nano crystals	Materials Letters 63 (2009) 1910-1913 ISSN: 0167-577X IF: 2.572 <a href="https://doi.org/10.1016/j.matlet.2009.06.003">10.1016/j.matlet.2009.06.003</a>	Manoj K. Gupta, Nidhi Sinha, B. K. Singh, Neelam Singh,.....& Binay Kumar
(3) 2009	Flux growth and low temperature dielectric relaxation in piezoelectric $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$ single crystals	Cryst. Res. Technol. 44 (2009) 915-924 ISSN: 0232-1300 IF: 1.0 <a href="https://doi.org/10.1002/crat.200900294">10.1002/crat.200900294</a>	B. K. Singh, Krishna Kumar, Nidhi Sinha & Binay Kumar
(2) 2009	Evidence of additional phase transitions at lower temperatures in the flux grown $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}\text{O}_3$ single crystal.	Materials Letters 63 (2009) 625-628 ISSN: 0167-577X IF: 2.572 <a href="https://doi.org/10.1016/j.matlet.2008.12.006">10.1016/j.matlet.2008.12.006</a>	B. K. Singh & Binay Kumar
(1) 2009	Solution Growth and Comparative Characterization of L-HFB Single Crystals	Cryst. Res. Technol. 44 (2009) 167-172 ISSN: 0232-1300 IF: 1.0 <a href="https://doi.org/10.1002/crat.200800190">10.1002/crat.200800190</a>	Nidhi Sinha, Sahas, B.K. Singh, K. Kumar, .... & Binay Kumar

**Review Article:**

“Growth and Characterization of  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  High Tc Superconducting Single Crystals”

Co authors: P. Kumar, I.K. Bdikin and G.C. Triguñayát. In: Superconductivity Research Horizons, Ed: E.H. Peterson, Nova Science Publisher, Inc, USA, p. 71-110 (2007).

**Reviewed** more than 30 submitted papers in Journals like Nature, Nano Scale, ACS Appl. Mater. Interfaces, J of Crystal Growth, Materials Letters, Crystal Growth and Design, RSC advances, Materials Research Bulletin, Science of Advanced Materials, Ceramics International, Materials Science and Engineering, etc.

**Examined** more than thirty five Ph.D. thesis and conducted Ph.D. viva voce of over twenty five Ph.D. students of other Universities.

### Projects (Major Grants) during Past 5 years

Sr.No.	Title	Cost (in rupees)	Duration	Agency
6	Fabrication and characterization of piezoelectric nanocrystals-organic hybrid sheet for energy harvesting and pressure sensor	72 Lac	Oct 2016-Oct 2019	SERB DST
5	Flux growth of $Pb(Mg_{1/3}Nb_{2/3})O_3-PbTiO_3$ (PMNT) single crystals for piezoelectric and pyroelectric applications	86 Lac	June 2015- Dec 2018	ARMREB, DRDO
4	Growth and characterization of n- and p-type ZnO nanostructure for optoelectronic applications	7 Lac	July2012- July2015	UGC
3	Growth of Device Level Lead free Alkali-Based Piezoelectric Single Crystals	25 Lac	Oct-2011- April 2015	DST
2	Growth of Device Level Non Linear Optical Organic/Semi- Organic Single Crystals By Various Methods	35 Lac	Nov 2009- Sept 2013	DU DST PURSE GRANT
1	Synthesis of High Performance Piezoelectric Ceramic & Crystals for Device Fabrication	46 Lac	Sept 2007- March 2011	DST

**University R&D grant:** Received R & D grant from Delhi University six times on the topic like

- (i) Growth and Characterization of Doped ZnO Nano-Crystals
- (ii) Energy harvesting through piezoelectric Nano-Crystals
- (iii) Piezoelectric, Dielectric and Structural Studies on undoped and doped BNKT Ceramic and Crystal
- (iv) Growth and Characterization of Organic Piezoelectric Crystals

**Ph.D. Supervision:** Fifteen students have been awarded Ph.D. Degree under the supervision of Prtof. Binay Kumar; Eight are currently working as Ph.D. student.

Sr. No.	Name of Student	Awarded	Ph.D. Thesis Title
15.	Sonu Kumar	Oct. , 2018	“Growth of Organic and Inorganic Single Crystals by Czochralski and Solution Techniques and their Structural, Electrical and Mechanical Characterization”
14.	Harsh Yadav	July 2017	“Morphological, optical and dielectric studies of piezoelectric crystals grown by solution and modified Czochralski techniques for patch antenna fabrication”
13.	Jyoti	April 2017	“Growth of piezoelectric non-linear optical organic/semi organic single crystals and their structural, optical, thermal and dielectric characterizations”
12.	N. Tyagi	Aug., 2016	“Structural, piezoelectric, ferroelectric, dielectric and mechanical properties in amino acid based single crystals”
11.	S. Bhandari	Dec., 2015	“Processing lead free perovskite ceramics, single crystal growth and characterization of pure and Mn-doped $\text{Bi}_{0.5}(\text{Na}_{1-y}\text{K}_y)_{0.5}\text{TiO}_3$ relaxor-like ferroelectrics”
10.	S. Godara	Dec., 2015	“Ferroelectric, ferromagnetic, dielectric and structural characterization of pure and substituted Multiferroic Bismuth ferrite ( $\text{BiFeO}_3$ ) nanoparticles synthesized by auto-combustion route”
9.	G. Ray	April, 2015	“Ceramic synthesis, crystal growth and characterization of pure and Sb-modified lead free ferroelectric ternary perovskite sodium potassium lithium niobate”
8.	N. Goel	Oct, 2012	“Structural, thermal, optical & dielectric characterization of solution grown pure and doped semi organic sodium phthalate single crystals”
7.	S. K. Khushwaha	May, 2012	“Growth and investigation for crystalline perfection <i>vis-à-vis</i> physical properties of pure and doped $\text{LiNbO}_3$ , Benzophenone and ZTS NLO single crystals”
6.	M. K. Gupta	June, 2011	“Growth of Doped and Undoped ZnO Nanostructure & their Morphological, Structural, Optical, Dielectric and Piezoelectric Characterization”

5.	N. Singh	June, 2011	“Structural, Optical And Dielectric Characterization of Solution grown Organic/Semi Organic Single Crystals”
4.	K. Kumar	Oct, 2010	“Synthesis and Characterization of Pure and (Sb,Nb,Ta)-doped Lead Free Piezoelectric $[\text{Bi}_{0.5}(\text{Na}_{1-x}\text{K}_x)_{0.5}]\text{TiO}_3$ Ceramics”
3.	B. K. Singh	March, 2010	“Structural, Piezoelectric, Dielectric, Optical and Electrical Characterization of Flux Grown $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}\text{O}_3$ Single Crystal”
2.	G.C. Budakoti	2006	“Growth, Characterization and Improvement of Undoped and Fe- doped high $T_c$ $\text{LiNbO}_3$ single crystals”
1.	P. Kumar	2005	“Study of as grown and annealed $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ high $T_c$ superconducting single crystals grown by self flux technique”

### Teaching Experience ( Subjects/Courses Taught)

Atomic & Molecular Physics, Electronics, Solid State Physics (Core papers, M.Sc. (F) and (P))

Advanced Solid State Physics Lab, Nanomaterials Lab (M.Sc. Final)

Solid State Physics Lab, Waves & Optics Lab (M.Sc. Previous)

### Invited Talk and other presentations in International/ National Conferences

- [1] Invited Talk “New Geometrical Modeling To Study Crystal Morphology: Requirement of modeling in crystal growth” in the **International Symposium on Modeling of Crystalline Growth Processes and Devices** at SSN College of Engineering, 26-28 Feb 2019.
- [2] Invited Talk “Technologically Important Piezoelectric Crystals” in **23 NSCGA**, Bhartiya University, Coimbatore 28-30Jan 2019
- [3] **Invited Talk High Performance Perovskite Crystals for Ferro-/piezoelectric Applications, ICPST, 16-18 Jan 2019 at DU**
- [4] Key Note Lecture “Understanding Crystals: Growth, Characterization and Applications: Energy Harvesting through Piezoelectric Materials”, CGC AnnaUniversity 3-5 Jan 2019
- [5] **Invited Talk “High performance piezoelectric materials for energy storage and harvesting” in “Materials & Technologies for Energy Conversion and Storage”** 26-29 September 2018 DAE-Convention Centre, BARC, Mumbai
- [6] **Invited Talk “High performance piezoelectric crystals and nanoparticles for energy harvesting” in “Recent Innovations in Advanced Materials (RIAM-2018): Physics of Advanced Materials”** 18-19 September 2018 at CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal.
- [7] **Two Popular lecture on (i) “Crystals for Society: Importance of Growth and Characterization” (ii) “Piezoelectric Applications of Crystals” in Department of Physics, VIT University Vellore, 17 Aug. 2018**
- [8] **Plenary Talk “Low Cost Czochralski Systems for Organic Crystals” in “National Conference on Processing and Fabrication of Advanced Materials”** 1-2 March 2018, SSN College of Engineering, Chennai; **Advisory Committee**



**member and Chairing a Technical Session**

- [9] **Invited Talk** "Growth and Characterization of Technologically Important Crystals for Piezoelectric Applications" in "22<sup>nd</sup> International Conference of the International Academy of Physical Sciences (CONIAPS-XXII) Avadh University, Faizabad
- [10] **Invited Talk** "Ternary/Quaternary Perovskite Materials for Piezo-/Ferroelectric Applications" in "**Recent Trends in Condensed Matter Physics**" Oct 31-Nov 3, 2017, Bose Institute, Kolkata; Chairing a technical Session.
- [11] **Invited Talk** "Perovskite Functional Crystals for Ferro-/Pyro-/Piezoelectric Applications" in "**45th National Seminar on Crystallography**" 9-12 July, 2017 Indian Institute of Technology (BHU), Varanasi
- [12] **Invited Talk** in the **25th AACGE Western Section Conference on Crystal Growth & Epitaxy, June 12-15, 2016, in California, USA.** "Flux grown alkali based perovskite crystals for piezoelectric applications"
- [13] **Popular Talk** on "High performance piezoelectric crystals" in the Department of Chemistry (Prof. Cava Group), **Princeton University, USA**, 17 June 2016.
- [14] **Invited Talk** in Twenty Sixth National Seminar On Crystal Growth and Epitaxy (XXVI-NSCGE) during March14-15, 2016., Crystal Growth Center, Anna University, **Advisory Committee member and Chairing a Technical Session**
- [15] **Invited Talk** in 20th National Seminar on Crystal Growth and Applications (NSCGA), January 19 - 21, 2016, BARC, Mumbai, **Advisory Committee member and Chairing a Technical Session**
- [16] **Invited Talk** in National Seminar on X-Ray Crystallography (NSXC-2014), Madurai Kamraj University, Tamilnadu, 29-Sept-1 Oct 2014, **Chairing a Technical Session**
- [17] **Invited talk** in 43 A National Seminar on Crystallography, IISER Mohali, Chandigarh March 2014; **Advisory Committee member and Chairing a Technical Session**
- [18] **Invited talk** in National Seminar on Crystal Growth, SSN college of Engineering Feb 2014; **Advisory Committee member and Chairing a Technical Session**
- [19] **Invited talk** in VIT March 2014, **International Advisory Committee member**
- [20] **Invited talk** in 42 National Seminar on Crystallography, at JNU Nov 2013; **Advisory Committee member and Chairing a Technical Session**
- [21] **Invited talk** in International Workshop and Seminar on Crystal Growth, Crystal Growth Center, Anna University, Dec 2012
- [22] **Invited talk** in the 3<sup>rd</sup> Collaborative Conference on Crystal Growth (3CG) Orlando, Florida **USA** during 11-15 Dec 2012 on "Optoelectronic and nano generator applications of ZnO nanocrystals" **International Advisory Committee member and Chairing a Technical Session on Nano-Energy.**
- [23] **Invited talk** on in the International Workshop on Crystal Growth and Characterization of Advanced Materials and Devices' and 'XXIV National Seminar on Crystal Growth' 16-22 December 2012, in crystal Growth Center, Anna University, Chennai; **Chairing a Technical Session.**
- [24] **Invited Talk** in International Conference and Workshop on Nano-Structured ceramics and other Nanomaterials (ICWNCN)" March 13<sup>th</sup> – 16<sup>th</sup>, 2012 at University of Delhi, New Delhi. **Core Organizing Group member and Chairing a Technical Session.**
- [25] **Invited Talk** on "Energy harvesting through Piezoelectric ZnO nanorods" 3<sup>rd</sup> International Conference on Current Development in Atomic, Molecular, Optical and Nano Physics" Dec 14-16, 2011, University of Delhi; **Core organizing group member.**
- [26] **Invited Talk** on "ZnO Nanorods: Optical and Nanogenerator Applications" in the "International Conference on Nanomaterials & Nanotechnology (ICNANO) 18-21 December, 2011 University of Delhi, Delhi" **Core organizing group member.**
- [27] **Invited Talk** on "Study of crystal growth and defect features by optical, scanning and tunneling microscope" in the XV National Seminar on Crystal Growth from 23-25, February 2011. Tirunelveli – Tamil Nadu
- [28] **Invited Talk** on "Growth and characterization of technologically important crystals" in UGC Sponsored Conference on "Recent Trends in Materials Research" during 29th - 30th January, 2011, Kalyan, Mumbai.
- [29] **Invited Talk** "Quality control of technologically important crystals for various applications" in National Symposium "Synthesis, Characterization and Applications of Technologically Important Material" 5-6 Jan. 2010, BHU, Varanasi.
- [30] **Key Note address** "Need of Technologically Important Crystals" at UGC sponsored "National Conference on Recent

Trends in Material Synthesis and Characterization”, at Nagpur, 4<sup>th</sup> - 5<sup>th</sup> December 2009.

- [31] **Five papers** are presented in “The 17th American Conference on Crystal Growth and Epitaxy (9-14 August, 2009) at Lake Geneva, **Wisconsin, USA**”.
- [32] **Invited Talk** “Pb-based and Pb-free piezoelectric systems for high performance applications” in International Conference on Electroceramics, Delhi 13-17 Dec. 2009.
- [33] **Invited Talk** “Development of high performance piezoelectric single crystals for applications” at Variable Energy Cyclotron Center, Kolkata, 18<sup>th</sup> June 09.
- [34] **Invited Talk** “High performance piezoelectric crystals: Growth, Characterization and Applications” in National Conference on Advanced Materials – Processing, Characterization and Applications. Tirunelveli, Tamilnadu, Aug. 09.
- [35] **Five Invited (Popular) Talks** at Crystal Growth Center, Anna University as **Senior Associate in UGC:CGC-AU Facility, March, 09**. (a) Enhancement of crystalline and material properties of superconducting Bi-2212 and piezoelectric LiNbO<sub>3</sub> single crystals through post growth treatments (b) Piezoelectric, dielectric and structural characterization of flux grown PZNT single crystals (c) Morphology and growth features on variously grown crystals (d) Quality control of semiorganic NLO single crystals through optimization of pH-value (e) Need of Pb-free high performance piezoelectric system.
- [36] **Invited Talk** “Growth and characterization of Pb-based and Pb-free Piezoelectric crystals” In: 13<sup>th</sup> National Seminar on Crystal Growth 27-29 Jan 2009 SSN College of Engineering, Tamil Nadu. Collected Abstract Page I-11.
- [37] **Invited Talk** “Crystals: Through the eyes of microscope” by Binay Kumar. In: National Conference on Microscopy and Allied Fields 17-20 Jan 2009, Jhansi, Collected Abstract p.37-38.
- [38] **Invited Talk** “High performance piezoelectric crystals: Growth, Characterization and Applications” in National Conference on Advanced Materials – Processing, Characterization and Applications. Tirunelveli, Tamilnadu, Aug. 09.
- [39] **Invited Talk** and Four contributory Papers in “The 13<sup>th</sup> National Seminar on Crystal Growth (27-29 January, 2009) SSN College, SSN Nagar, Chennai, Tamilnadu”.
- [40] **Four contributory papers** in “The 38<sup>th</sup> National Seminar on Crystallography, University of Mysore, 11-13 February 2009.

## DETAILS OF RESEARCH WORK

**Lead-free alkali based piezoelectric (pure and doped BNKT, NKLN, etc) systems** have been synthesized after optimizing composition and sintering temperature. Single crystals of BNKT and NKLN were grown by flux method. Enhanced dielectric, piezoelectric and ferroelectric properties with improved depolarization and transition temperature were achieved for high temperature applications for repeated cycles.

**Project:** One DST Project “Growth of Device Level Lead free Alkali-Based Piezoelectric Single Crystals” from DST is completed in April 2015 (Rs. 25 Lac).

**Manpower Trained:** Three students have completed Ph.D. work as

- (i) “Synthesis and Characterization of Pure and (Sb,Nb,Ta)-doped Lead Free Piezoelectric [Bi<sub>0.5</sub>(Na<sub>1-x</sub>K<sub>x</sub>)<sub>0.5</sub>]TiO<sub>3</sub> Ceramics” (2010)
- (ii) “Ceramic synthesis, crystal growth and characterization of pure and Sb-modified lead free ferroelectric ternary perovskite sodium potassium lithium niobate” (2015)
- (iii) “Processing lead free perovskite ceramics, single crystal growth and characterization of pure and Mn-doped Bi<sub>0.5</sub>(Na<sub>1-y</sub>K<sub>y</sub>)<sub>0.5</sub>TiO<sub>3</sub> relaxor-like ferroelectrics” (2015)

**ZnO/BFO nano-particles** have been synthesized by low cost chemical route and piezoelectric, dielectric aspects have been studied. Oriented ZnO nanorods of diameter 20-30 nm and length 80-250 nm have been grown. Effect of doping (K-, Li-, V-, Cr-, etc) on dielectric, ferroelectric, optical, etc properties of ZnO has been studied. Main achievements on these studies are (a) growth of p-type ZnO nanorods (b) enhancement of ferroelectric and dielectric properties (c) band gap tuning, etc. It has been demonstrated that these nanorods can be used for LED, Sensor and Nanogenerator applications. BFO nanoparticles were synthesized by chemical auto combustion method and characterized for ferroelectric, ferromagnetic, dielectric, etc behavior. Effect of co-doping of Ba, Nb, Cr, Ce etc were studied.

**Project:** (i) UGC project “Growth and characterization of n- and p-type ZnO nanostructure for optoelectronic applications” is recently completed in July 2015 (7.5 Lac).

(iii) SERB, DST project “Fabrication and characterization of piezoelectric nanocrystals-organic hybrid sheet for energy harvesting and pressure sensor” Oct 2016-2019 (72 Lac)

**Manpower Trained:** Two students have completed their Ph.D. work on

(i) “Growth of Doped and Undoped ZnO Nanostructure and Their Morphological Structural, Optical, Dielectric & Piezoelectric Characterization” (2012).

(ii) “Ferroelectric, ferromagnetic, dielectric and structural characterization of pure and substituted Multiferroic Bismuth ferrite ( $\text{BiFeO}_3$ ) nanoparticles synthesized by auto-combustion route” (2015)

**Lead Based Piezoelectric (i)  $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$  (PZN-PT) and (ii)  $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3\text{-PbTiO}_3$  (PMN-PT) single crystals:** PZN-PT single crystals have been grown by flux method of sizes upto 8-9 mm across. The main achievements are increased perovskite phase, higher  $d_{33}$  values (~2400 pC/N compare 20 pC/N for  $\text{LiNbO}_3$  and 450 pC/N for PZT) and better dielectric and mechanical properties. Work on the quality improvement has been undertaken and their suitability for device fabrication has been established.

Work on the synthesis and crystal growth of PMN-PT system has been started recently.

**Project:**

(i) DST project “Synthesis of High Performance Piezoelectric Ceramic & Crystals for Device Fabrication” Sept. 2007-March 2011 (Rs. 46 Lac) has been completed.

(ii) DRDO ARMREB project “Flux growth of  $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3\text{-PbTiO}_3$  (PMNT) single crystals for piezoelectric and pyroelectric applications” (Sanction No ARMREB/MAA/2015/163; 85 lac)

**Manpower Trained:** One student received his Ph.D. degree in 2010 on “Structural, Piezoelectric, Dielectric, Optical and Electrical Characterization of Flux Grown  $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$  Single Crystal”.

**Organic and Semiorganic (Anthracene, Benzil, TGS, Glycine, LHFB, Phthalate, Benzophenon, etc) single crystals** are grown by various techniques like slow evaporation, temperature lowering method, CZ method, seed rotation method, SR method, etc. Large variety of crystals for semiconducting, ferroelectric, Non Linear Optial, etc applications have been grown of sizes from few mm to several cm. They were characterized for structural, dielectric, ferroelectric, optical, etc behavior. These crystals were used for the fabrication of patch antenna for communication applications

**Project:** DST-DU PURSE project “Growth of Device level NLO Organic/Semi- Organic single crystals by various methods” is currently under progress Nov 2009- March 2013; (Rs 35 Lac) has been completed.

**Manpower Trained:** Three Ph.D. student has have completed Ph.D. work

- (i) “Growth of piezoelectric non-linear optical organic/semi organic single crystals and their structural, optical, thermal and dielectric characterizations” Submitted in April 2016.
- (ii) “Structural, piezoelectric, ferroelectric, dielectric and mechanical properties in amino acid based single crystals” in 2016
- (iii) “Structural, thermal, optical & dielectric characterization of solution grown pure and doped semi organic sodium phthalate single crystals” in 2012.
- (iv) “Structural, optical and dielectric characterization of solution grown organic/semi-rganic Single Crystals” in 2011.

**High temperature superconducting  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  (Bi-2212) single crystals and Y-123 ceramic** are grown by self flux method and characterized by various techniques. The main achievement was to enhance transition temperature & crystal qualities by post growth annealing under varying conditions.

**Project:** Completed UGC project (2001-2004) on “High T<sub>c</sub> Superconducting Crystals” (17 Lac).

**Manpower Trained:** One student got his Ph. D. degree titled “Study of as grown and annealed  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$  high T<sub>c</sub> superconducting single crystals grown by self flux technique”.

**Review Article:** “Growth and Characterization of  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  High T<sub>c</sub> Superconducting Single Crystals” P. Kumar, Binay Kumar, I.K. Bdikin and G.C. Triganayat. In: "Superconductivity Research Horizons"; Ed: Eugene H. Peterson ; Chapter 3 pp.71-110 (2007) Nova Science Publisher, Inc, USA, (ISBN: 1-60021-510-6).

**Piezoelectric  $\text{LiNbO}_3$  single crystals** are grown by Cz method (at NPL). The highlight of the works on undoped and Fe-doped LN crystals was to achieve highest values of piezoelectric charge coefficient ( $d_{33}$  pC/N) and removal of small angle grain boundaries (lowest ever reported values of half widths of the rocking curve in the HRXRD) by a combination of annealing and poling processes.

**Manpower Trained:** Two students got their Ph.D. degree

- (i) “Growth, Characterization and Improvement of Undoped and Fe- doped high T<sub>c</sub>  $\text{LiNbO}_3$  single crystals” in 2006
- (ii) “Growth and investigation for crystalline perfection *vis-à-vis* physical properties of pure and doped  $\text{LiNbO}_3$ , Benzophenone and ZTS NLO single crystals” in 2012

**As a Ph.D. Student in Delhi University during 1988-91, Binay Kumar** worked on the Growth of dendritic single crystals of pure and doped CdI<sub>2</sub> by vapour method and their characterization with respect to structural changes due to doping. Single crystals of various systems were also grown by solution methods and horizontal and vertical moving zone systems. Zone refining systems were designed and fabricated for the purification of metal halides to spectroscopic level.

The Ph.D. title was “Polytypism of vapour grown dendritic single crystals of both undoped and doped cadmium iodide”

1. “Polytypism in PbI<sub>2</sub>-doped dendritic single crystals of cadmium iodide”. Binay Kumar and G. C. Trigunayat. Acta Cryst. A47, p.263-267 (1991).
2. “Vapour growth and characterization of cadmium iodide dendritic single crystals”. Binay Kumar and G. C. Trigunayat. Proc. Ind. Nat. Sc. Acad. A57, No.2, p.231-239 (1991).
3. “Dendritic growth of PbI<sub>2</sub> single crystals and study of their polytypism and growth features”. Binay Kumar and G.C. Trigunayat. Acta Cryst. A 48, p.733-736 (1992).
4. “Growth and characterization of KDP-doped dendritic single crystals of cadmium iodide”. Binay Kumar and G.C. Trigunayat. Phase Transition, 43, p.145-152 (1993).
5. “Effect of variation in PbI<sub>2</sub> doping on the polytypism of dendritic CdI<sub>2</sub> single crystals”. Binay Kumar and G.C. Trigunayat. J. Appl. Cryst., 43, p.41-46 (1993).
6. “Polytypism and related phenomena in CdBr<sub>2</sub>-doped dendritic single crystals of cadmium iodide”. Binay Kumar and G.C. Trigunayat. Acta Cryst., A54, p.682-685 (1998).
7. “Micromorphology of pure and PbI<sub>2</sub>-doped CdI<sub>2</sub> Dendritic Single crystals”. Binay Kumar and Nidhi Sinha. Crystal Res. Tech. 40, No.9 p.887-892 (2005).

#### **Membership of Professional Societies**

1. Indian Crystallographic Association, (Member, National Executive committee)
2. Semiconductor Society of India
3. Indian Association of Physics Teachers
4. Electron Microscopic Society of India

(Signature of Faculty Member)

(Signature & Stamp of

Head of the Department)