




# Dr. Binay Kumar

Crystal Lab, Department of Physics & Astrophysics,

University of Delhi, Delhi-110007 (INDIA)



Title	DR.	First Name	BINAY	Last Name	Kumar	Photograph
Designation		Associate Professor				
Department		Physics & Astrophysics				
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Education						
Subject	Institution	Year	Details			
Ph. D.	University of Delhi	1992	Thesis topic: Polytypism of vapour grown dendritic single crystals of both undoped and doped cadmium iodide			
M. Sc.	Bhagalpur University	1986	Subjects: Physics			
B. Sc. (H)	Bhagalpur University	1983	Subjects: Physics, Chemistry Mathematics			
Career Profile						
Organization / Institution	Designation	Duration	Role			
University of Delhi	Associate Professor	1 Jan 2006-Till date	Teaching & Research			
University of Delhi	Reader	June 2001-31 Dec 2005	Teaching & Research			
University of Delhi	Lecturer (& Senior Sc)	Jan1993-June 2001	Teaching & Research			
University of Delhi	Research Associate	Aug.1992-Jan 1993	Teaching & Research			
<b>Research Interests / Specialization</b>						

## Research Work of DR. BINAY KUMAR (2004 onwards)

Dr. Binay Kumar started a new lab in 2004 (hereby known as 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. PZN-PT, LiNBO<sub>3</sub>, Lead free alkali based materials, etc.), high T<sub>c</sub> superconductors (e.g. Bi-2212 system), ZnO nano structure, MX<sub>2</sub> compounds, Organic & Semi-organic NLO materials and their characterization are being undertaken. Enhancement of crystallographic and material properties by various pre- and post-growth treatments and doping to make these crystals more suitable for application is one of the targets of our research work. Single crystals are grown by flux, solution, vapor, zone traveling etc. techniques while the characterization include techniques like XRD, SEM, TEM, AFM, TGA, Dielectric (conductivity, etc.) Piezometry (d<sub>33</sub>), Ferroelectric (P-E loop, etc), UV-Vis, FTIR etc, etc.

In the past eight years four major projects have been undertaken; six students have got Ph.D. degree while nearly 50 papers have been published in refereed International Journals.

**Research work done during past 7-8 years on some important class of materials is summarized below:**

**ZnO nano rods** have been grown by low cost chemical route and piezoelectric, dielectric aspects have been studied. Oriented 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.

1. “Dielectric studies and band gap tuning of ferroelectric Cr-doped ZnO Nanorods” Manoj K. Gupta, Nidhi Sinha and Binay Kumar, Journal of Applied Physics 112, 014303 (2012).
2. “High T<sub>c</sub> ferroelectricity in V-doped ZnO nanorods” Manoj Kumar Gupta and Binay Kumar, Journal of Materials Chemistry, , 21, 14559-14562 (2011).
3. “p- type K -doped ZnO Nanorods for opto-electronic applications” Manoj K. Gupta, Nidhi Sinha and Binay Kumar, Journal of Applied Physics 109, 083532 (2011).
4. “Enhanced ferroelectric, dielectric and optical behaviour in Li-doped ZnO nanorods” Manoj K. Gupta and Binay Kumar, Journal of Alloys and Compound 509 (2011) L208–L212.
5. “Synthesis of K-doped p-type ZnO nanorods along (100) for ferroelectric and dielectric applications” Manoj K Gupta, Nidhi Sinha, BK Singh and Binay Kumar, Materials Letters, 64 1825-28 (2010).
6. “Synthesis and Comparative Study of ZnO Nanorods for Structural, Optical and Dielectric Behaviour” M.K. Gupta, Nidhi Sinha and Binay Kumar Integrated Ferroelectrics, 118:61–66 (2010).
7. “Piezoelectric, dielectric, optical and electrical characterization of solution grown ZnO nano crystals” M.K. Gupta, N. Sinha, BK Singh, N. Singh, K. Kumar and Binay Kumar. Material Letters 63 1910-1913 (2009).

**Manpower Trained:** One student has got his Ph.D. degree in 2011 on “Growth of Doped and Undoped ZnO Nanostructure and Their Morphological Structural, Optical, Dielectric & Piezoelectric Characterization”.

**Piezoelectric  $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$  (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 20pC/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. Completed a DST project “Synthesis of High Performance Piezoelectric Ceramic & Crystals for Device Fabrication” Sept. 2007-March 11 (Rs. 46 Lac).

1. “Investigation of glassy behaviour of flux grown  $\text{Pb}[(\text{Zn}_{1/3}\text{Nb}_{2/3})_{0.91}\text{Ti}_{0.09}]\text{O}_3$  crystal” B.K. Singh and Binay Kumar *Physica B* 406 941–945 (2011).
2. “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,” B. K. Singh, K. Kumar, M. K. Gupta and Binay Kumar, *Status Solidi A*, 1–7 (2010) / DOI 10.1002/pssa. 200925643.doc.
3. “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” B. K. Singh and Binay Kumar *Cryst. Res. Technol.* 45, 1003 – 1011 (2010).
4. “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” B.K. Singh, K. Kumar, Nidhi Sinha and Binay Kumar. *Cryst. Res. Technol* 44 No.9 915-924 (2009).
5. “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” B.K. Singh and Binay Kumar. *Materials Letters* 63, p.625–628 (2009).

**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, TGS, Glycine, LHFB, Phthalate, etc) single crystals** are grown by various solution techniques like slow evaporation, temperature lowering method, seed rotation method, SR method, etc. Large variety of crystals for semiconducting, ferroelectric, Non Linear Optical, etc applications have been grown of sizes from few mm to several cm. They were characterized for structural, dielectric, ferroelectric, optical, etc behavior. One 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).

1. “Crystal growth, optical, mechanical and electrical properties of Inorganic material: Sodium tetraborate decahydrate” Neeti Goel, Nidhi Sinha and Binay Kumar, *Materials Research Bulletin* 48 (2013) 1632–1636
2. “Enhanced Optical, NLO, dielectric and thermal properties of novel sodium hydrogen phthalate single crystals doped with Zinc” Neeti Goel, Nidhi Sinha and Binay Kumar, *Optical Materials* 35 (2013) 479–486
3. “Improvement in Structural, Dielectric, Ferroelectric and Mechanical Properties in Metal Ions Doped Glycine Phosphite Single Crystals” K. Senthilkumar, Moorthy Babu, Binay Kumar, G. Bhagavannarayana, *Ferroelectrics* (2012, InPress) Manuscript ID: 741992
4. “Remarkable Enhancement in optical and thermal properties of sodium hydrogen phthalate crystals due to  $\text{Fe}^{3+}$  doping” Neeti Goel and Binay Kumar, *Journal of Crystal Growth* 361 44–50 (2012).
5. “Enhancement in ferroelectric, pyroelectric and photoluminescence properties in dye doped TGS crystals” Nidhi Sinha, Neeti Goel, B.K. Singh, M.K. Gupta and Binay Kumar. *Journal of Solid State Chemistry* 190 180-185

(2012).

6. "Effect of rare earth ions on the properties of glycine phosphate single crystals" K. Senthilkumar, S. Moorthy Babu, Binay Kumar, G.Bhagavannarayana, *Journal of Crystal Growth* doi:10.1016/j.jcrysgro.2011.10.031 In Press (2012).
7. "A comparative study of ferroelectric triglycine sulfate (TGS) crystals grown by conventional slow evaporation and unidirectional method" M. Senthil Pandian, P. Ramasamy, Binay Kumar *Journal of Materials Research and Bulletin*, In Press (2012).
8. "Optical and dielectric studies of solution grown glycinium maleate single crystal, Neelam Singh, B.K. Singh, M.K. Gupta, Binay Kumar, *Optics Communications* 285 659–664 (2012).
9. "Effect of zinc chloride on structural, optical and dielectric behavior of solution grown anthracene crystal" Nidhi Sinha, Manoj K. Gupta, Neeti Goel, Binay Kumar *Physica B* 406 3206–3209 (2011).
10. "Structural, optical and dielectric studies of Glycinium trifluoroacetate single crystal" Neelam Singh and Binay Kumar *Physica B: Condensed Matter*, 406 2152–2157 (2011).
11. "Enhancement in crystalline perfection and optical properties of benzophenone single crystals: the remarkable effect of a liquid crystal" S. K. Kushwaha, N. Vijayan, K. K. Maurya, A. Kumar, B. Kumar, K. Somayajulu and G. Bhagavannarayana *J. Appl. Cryst.* 44, 839–845 (2011).
12. Growth and characterization of new semi organic L-proline strontium chloride monohydrate single crystals" Manoj K. Gupta, Nidhi Sinha and Binay Kumar, *Physica B: Condensed Matter* 406 63 (2011).
13. "Structural, Dielectric, Optical and Ferroelectric property of Urea Succinic Acid Crystals grown in aqueous solution containing Maleic Acid", B. K. Singh, N. Sinha, N. Singh, K. Kumr, M. K. Gupta and Binay Kumar *Journal of Physics and Chemistry of Solids* 711774–1779 (2010).
14. "Organic Ferroelectrics: A Big Surprise", Mohd. Shakir, B.K.Singh, Binay Kumar and G. Bhagavannarayana, *Nature Asia Materials Research Highlight*, doi: 10.1038/asiamat.2010.48, (2010).
15. "Growth of 1 0 0 directed ADP crystal with slotted ampoule" *Current Applied Physics*, In Press, P. Rajesh, P. Ramasamy, G. Bhagavannarayana, Binay Kumar *Current Applied Physics* 10 1221-1226 (2010).
16. "Effect of ion irradiation on the m-Nitroaniline single crystals" T. Kanagasekaran, P. Mythili, Binay Kumar and R. Gopalakrishnan. *Nucl. Instr. and Meth. in Phys. Res. B* 268 36–41 (2010).
17. "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" P. Rajesh, P. Ramasamy, Binay Kumar and G. Bhagavannarayana. *Physica B* 405 2401-06 (2010).
18. "Solution Growth and Comparative Characterization of L-HFB Single Crystals" Nidhi Sinha, Sahas, B.K. Singh, N. Singh, K. Kumar, M.K. Gupta, G.C. Budakoti and Binay Kumar. *Cryst. Res. Technol.* 44, 167-172 (2009).
19. "Ferroelectricity in glycine picrate: An astonishing observation in a centrosymmetric crystal" M. Shakir, B. K. Singh, B. Kumar, and G. Bhagavannarayana, *Applied Physics Letters*, 95, 252902:1-3, (2009).
20. "Growth and Characterization of new nonlinear optical Thiourea L-alanine acetate (TLAA) single crystal".

**Manpower Trained:** Two: One Ph.D. student has received Ph.D. Degree in 2011 on “Structural, optical and dielectric characterization of solution grown Organic/Semi Organic single crystals”. Another Ph.D. student has submitted Ph.D. thesis on “Structural, thermal, optical & dielectric characterization of solution grown pure and doped semi organic sodium phthalate single crystals”

**Lead-free alkali based piezoelectric (BNKT, pure and Sb, Nb-doped) systems** have been synthesized. Effect of these doping on the enhancement of depolarization and transition temperature have been studied. One Project “Growth of Device Level Lead free Alkali-Based Piezoelectric Single Crystals” is currently under progress Oct.2011-Oct 2014 (Rs. 25 Lac).

1. “Synthesis, dielectric and relaxation behavior of lead free NBT–BT ceramics” S. Shanmuga Sundari, Binay Kumar, R. Dhanasekaran, *Ceramics International* (2012 In Press) doi.org/10.1016/j.ceramint.2012.06.063.
2. “Effect of SHI Irradiation on NBT-BT Ceramics: Transformation of Relaxor Ferroelectric to Ferroelectric Nature” S. Shanmuga Sundari, Binay Kumar, K. Asokan, R. Dhanasekaran *Applied Surface Science* (2012, In press) doi.org/10.1016/j.apsusc.2012.10.199.
3. “Effect of Nb-doping on dielectric, ferroelectric and conduction behavior of lead free  $\text{Bi}_{0.5}(\text{Na}_{0.5}\text{K}_{0.5})_{0.5}\text{TiO}_3$  ceramic”, Krishan Kumar and Binay Kumar, *Ceramics International* 38 1157–1165 (2012).
4. “Enhancement in dielectric and ferroelectric properties of lead free  $\text{Bi}_{0.5}(\text{Na}_{0.5}\text{K}_{0.5})_{0.5}\text{TiO}_3$  ceramics by Sb-doping” Krishan Kumar, B. K. Singh, M. K. Gupta, N. Sinha and Binay Kumar, *Ceramic International* 37, 2997-3004 (2011).
5. “Synthesis and characterization of Sb-doped  $\text{Bi}_{0.5}(\text{Na}_{0.5}\text{K}_{0.5})_{0.5}\text{TiO}_3$  ceramic” Krishan Kumar and Binay Kumar *Integrated Ferroelectrics*, 121:99–105 (2010).

**Manpower Trained:** One student has got Ph.D. Degree in 2010 on “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”.

**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 control/enhance the transition temperature and other crystal qualities by post growth annealing treatment under varying conditions. Completed UGC project on “High Tc Superconducting Crystals”.

1. “Structural changes in ab plane of Zn-doped Bi-2212 HTSC single crystals”. Lovleena, I.K. Bidikin, A.L. Kholkin and Binay Kumar *Physica C*, 451, p.44-48 (2007).
2. “IR-studies on  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\square}$  single crystals with different oxygen stoichiometry”. P. Kumar, G.C. Trigunayat and Binay Kumar. In: *Advances in Technologically Important Crystals*, Ed: Binay Kumar & R.P. Tandon, Macmillan p.87-92 (2007).
3. “X-ray and AFM studies of  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\square}$  single crystals grown by different methods”. I.K. Bidikin, A.N. Maljuk, A.B. Kulakov, C.T. Lin, P. Kumar, Binay Kumar, G.C. Trigunayat, G.A.Emel’chenko, A.L. Kholkin. *J*

Crystal Growth 275, No.1-2, p. e1799-1805 (2005).

4. “Comparative characterization of undoped and Zn-doped  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  single crystals grown by self flux technique”. Binay Kumar, P. Kumar, Lovleena, I.K. Bidikin and G.K. Chadha. Ind. J. of Cryogenics, 30, p.175-178 (2005).
5. “Effect of low temperature short time annealing on oxygen content and surface quality of  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  single crystals”. P. Kumar, Binay Kumar, D.N. Kumar and G.K. Chadha. Physica C 411 No.3-4, p.180-188 (2004).
6. “Surface morphology and incommensurate modulation of self-flux grown  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  single crystals”. P. Kumar, Binay Kumar, I. Bdikin, A.L. Kholkin and G.C. Trigunayat. Physica C 406 No.1-2, p.72-78 (2004).
7. “X-ray characterization of  $\text{Bi}_2\text{Sr}_2\text{CaCuO}_{8+\delta}$  single crystals grown by different methods”. I.K. Bdikin, A.N. Maljuk, A.B. Kulakov, T.C.Lin, P. Kumar, Binay Kumar and G.C. Trigunayat. Physica C 383, p.431 (2003).

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

**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 Tc superconducting single crystals grown by self flux technique”.

**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.

1. “Improvement in crystalline perfection, piezo-electric property and optical transparency of in-situ poled Fe- $\text{LiNbO}_3$  single crystals by post growth annealing and poling”. G.C. Budakoti, Binay Kumar, G. Bhagavannarayan and N. C. Soni. Phys. Stat. Solidi (a) (Rapid) 202 No2 p.R7-R9 (2005).
2. “A study of annealing on Fe-doped  $\text{LiNbO}_3$  by HRXRD, XRT and FTIR”. G. Bhagavannarayan, R.V. Anantha Murthi, G.C. Budakoti, Binay Kumar and K.S. Bartwal. J. Appl. Cryst. 38, p.768-771 (2005).
3. “Enhancement of crystalline, piezoelectric and optical quality of  $\text{LiNbO}_3$  single crystals by post-growth annealing and poling”. G. Bhagavannarayana, G.C. Budakoti, K.K. Maurya and Binay Kumar J. Crystal Growth 282, p.394-401 (2005).
4. “Study of annealing on defect structure in undoped and Fe-doped  $\text{LiNbO}_3$  crystals” G.C. Budakoti, , G. Bhagavannarayan and Binay Kumar. In: Advances in Technologically Important Crystals, Ed: Binay Kumar & R.P. Tandon, Macmillan p.157-161(2007).
5. “Crystalline perfection, Raman, UV-VIS-NIR and prism coupler investigations on Cz-grown pure and Zn-doped  $\text{LiNbO}_3$  single crystals” S. K. Kushwaha. K. K. Maurya, N. Vijayan, Binay Kumar, Rajeev Bhatt, S. Ganesamoorthy and G. Bhagavannarayana. Cryst Eng Comm DOI: 10.1039/c2ce06710b (2012).

**Manpower Trained:** Two: One student got his Ph.D. degree in 2006 on “Growth, Characterization and Improvement of Undoped and Fe- doped high T<sub>c</sub>  $\text{LiNbO}_3$  single crystals”. Another student has got his Ph.D. degree in Nov. 2012 on “Growth and investigation for crystalline perfection *vis-à-vis* physical properties of pure and doped  $\text{LiNbO}_3$ ,



Benzophenone and ZTS NLO single crystals”.

**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  $\text{CdI}_2$  by vapour method and their characterization with respect to structural changes due to doping. The Ph.D. title was “Polytypism of vapour grown dendritic single crystals of both undoped and doped cadmium iodide” (**Three publications in Acta Cryst A: Current Impact Factor is nearly 50**)

1. “Polytypism in  $\text{PbI}_2$ -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  $\text{PbI}_2$  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  $\text{PbI}_2$  doping on the polytypism of dendritic  $\text{CdI}_2$  single crystals”. Binay Kumar and G.C. Trigunayat. J. Appl. Cryst., 43, p.41-46 (1993).
6. “Polytypism and related phenomena in  $\text{CdBr}_2$ -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  $\text{PbI}_2$ -doped  $\text{CdI}_2$  Dendritic Single crystals”. Binay Kumar and Nidhi Sinha. Crystal Res. Tech. 40, No.9 p.887-892 (2005).

#### **Teaching Experience ( Subjects/Courses Taught)**

1992-present: Atomic & Molecular Physics, Electronics (Core papers, M.Sc. (F) and (P))  
Advanced Solid State Physics Expt Lab (M.Sc. Final)  
Solid State Physics Lab, Waves & Optics Lab (M.Sc. Previous)

Honors & Awards:

**RECENT PUBLICATIONS OF DR. BINAY KUMAR**  
(Past three years 2009-Till date Only)

In Indexed/ Peer Reviewed Journals

<u>Year</u>	<u>Title</u>	<u>Journal</u>	<u>Co-Author</u>
(38) 2013	“Crystal growth, optical, mechanical and electrical properties of Inorganic material: Sodium tetraborate decahydrate”	Materials Research Bulletin 48 (2013) 1632–1636	Neeti Goel, Nidhi Sinha
(37) 2013	Effect of rare earth ions on the properties of glycine phosphate single crystals	Journal of Crystal Growth, 362, 343-348 (2013)	K. Senthilkumar Moorthy Babu, G. Bhagavannarayana
(36) 2012	“Enhanced Optical, NLO, dielectric and thermal properties of novel sodium hydrogen phthalate single crystals doped with Zinc”	Optical Materials 35 (2013) 479–486	Neeti Goel, Nidhi Sinha
(35) 2012	“Effect of SHI Irradiation on NBT-BT Ceramics: Transformation of Relaxor Ferroelectric to Ferroelectric Nature”	Applied Surface Science (2012, In press) doi.org/10.1016/j.apsusc.2012.10.199	S. Shanmuga Sundari, K. Asokan, R. Dhanasekaran
(34) 2012	Improvement in Structural, Dielectric, Ferroelectric and Mechanical Properties in Metal Ions Doped Glycine Phosphite Single Crystals	Ferroelectrics, 437, 126-136 (2012)	K. Senthilkumar Moorthy Babu, G. Bhagavannarayana
(33) 2012	Remarkable Enhancement in optical and thermal properties of sodium hydrogen phthalate crystals due to Fe <sup>3+</sup> doping”	J. crystal Growth DOI: 10.1016/j.jcrysgro.2012.08.044 (2012).	Neeti Goel
(32) 2012	“Dielectric studies and band gap tuning of ferroelectric Cr-doped ZnO Nanorods”	Journal of Applied Physics 112, 014303 (2012)	Manoj K. Gupta, Nidhi Sinha
(31) 2012	Synthesis, dielectric and relaxation behavior of lead free NBT–BT ceramics	Ceramics International (2012 In Press) doi.org/10.1016/j.ceramint.2012.06.063	S. Shanmuga Sundari, R. Dhanasekaran,
(30) 2012	“Enhancement in ferroelectric, pyroelectric and photoluminescence properties in dye doped TGS crystals”	Journal of Solid State Chemistry 190 (2012) 180-185.	Nidhi Sinha, Neeti Goel, B.K. Singh, M.K. Gupta
(39) 2012	“Crystalline perfection, Raman, UV-VIS-NIR and prism coupler investigations on Cz-grown pure and Zn-doped LiNbO <sub>3</sub> single crystals”	Cryst Eng Comm ( 2012 In Press) .DOI: 10.1039/c2ce06710b	S. K. Kushwaha. K. K. Maurya, N. Vijayan, Rajeev Bhatt, S. Ganesa moorthy and G. Bhagavannarayana.
(28) 2012	“Effect of rare earth ions on the properties of glycine phosphate single crystals”	Journal of Crystal Growth doi:10.1016/j.jcrysgro.2011	K. Senthilkumar, S. Moorthy Babu, G. Bhagavannarayana
(27) 2012	“A comparative study of ferroelectric triglycine sulfate (TGS) crystals grown by conventional slow evaporation and unidirectional method”	Journal of Materials Research and Bulletin, In Press (2012).	M. Senthil Pandian, P. Ramasamy,
(26) 2012	“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	Krishan Kumar



(25) 2012	“Optical and dielectric studies of solution grown glyciniium maleate single crystal”	Optics Communications 285 (2012) 659–664.	N. Singh, B.K. Singh, M.K. Gupta
(24) 2011	High Tc Ferroelectricity in V-Doped ZnO’	Journal of Materials Chemistry, 2011, 21, 14559-14562	Manoj K. Gupta
(23) 2011	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 2011, 37, 2997-3004	K. Kumar, B. K. Singh, M. K. Gupta, N. Sinha
(22) 2011	Effect of zinc chloride on structural, optical and dielectric behavior of solution grown anthracene crystal	Physica B 406 (2011) 3206–3209.	Nidhi Sinha, Manoj K.Gupta , Neeti Goel
(21) 2011	p- type K -doped ZnO Nanorods for opto-electronic applications	Journal of Applied Physics 109, 083532 (2011).	Manoj K. Gupta, Nidhi Sinha
(20) 2011	Enhanced ferroelectric, dielectric and optical behaviour in Li-doped ZnO nanorods.	Journal of Alloys and Compound 509 (2011) L208–L212.	Manoj K. Gupta
(19) 2011	Structural, optical and dielectric studies of Glyciniium trifluoroacetate single crystal.	Physica B: Condensed Matter, 406 (2011) 2152–2157.	Neelam Singh
(18) 2011	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.	B.K. Singh
(17) 2011	Enhancement in crystalline perfection and optical properties of benzophenone single crystals: the remarkable effect of a liquid crystal	J. Appl. Cryst. (2011). 44, 839–845	S. K. Kushwaha, N. Vijayan, K. K. Maurya, A. Kumar, K. Somayajulu and G. Bhagavannarayana
(16) 2011	Growth and characterization of new semi organic L-proline strontium chloride monohydrate single crystals.	Physica B: Condensed Matter 406 (2011) 63.	Manoj K. Gupta, Nidhi Sinha
(15) 2010	Effect of electric field on dielectric, ac conduction and ferroelectric behavior 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> single crystals.	Phys. Status Solidi A, 1–7 (2010) / DOI 10.1002/pssa. 200925643.doc.	B. K. Singh, K. Kumar, M. K. Gupta
(14) 2010	Synthesis of K-doped p-type ZnO nanorods along (100) for ferroelectric and dielectric applications.	Materials Letters, 64 (2010)1825-28.	Manoj K Gupta, Nidhi Sinha, B.K. Singh.
(13) 2010	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.	B. K. Singh, N. Sinha, N. Singh, K. Kumr, M. K. Gupta
(12) 2010	Impedance analysis and high temperature conduction mechanism 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> single crystal.	Cryst. Res. Technol. 45, 1003 – 1011 (2010)	B. K. Singh
(11) 2010	Synthesis and Comparative Study of ZnO Nanorods for Structural, Optical and Dielectric Behaviour.	Integrated Ferroelectrics, 118:61–66, 2010.	M.K. Gupta, Nidhi Sinha

(10) 2010	Organic Ferroelectrics: A Big Surprise.	Nature Asia Materials Research Highlight, doi: 10.1038/asiamat.2010.48, (2010).	Mohd. Shakir, B.K.Singh, G. Bhagavannarayana,
(9) 2010	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, 121:99–105, 2010.	Krishan Kumar
(8) 2010	Growth of 1 0 0 directed ADP crystal with slotted ampoule.	Current Applied Physics 10 (2010) 1221-1226.	P. Rajesh, P. Ramasamy, G. Bhagavannarayana.
(7) 2010	“Effect of ion irradiation on the m-Nitroaniline single crystals”.	Nucl. Instr. and Meth. in Phys. Res. B 268 (2010) 36–41.	T. Kanagasekaran, P. Mythili, R.Gopalakrishnan
(6) 2010	Effect of cobalt and DL-malic acid on the growth rate, crystalline perfection, optical, ..... ADP single crystals.	Physica B 405 (2010) 2401-06.	P. Rajesh, P. Ramasamy, G. Bhagavannarayana.
(5) 2009	Piezoelectric, dielectric, optical and electrical characterization of solution grown ZnO nano crystals.	Material Letters 63 1910-1913 (2009).	M.K. Gupta, N. Sinha, BK Singh, N. Singh, K.Kumar
(4) 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 No.9 915-924 (2009).	B.K. Singh, K. Kumar, Nidhi Sinha
(3) 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, p.625–628 (2009).	B.K. Singh
(2) 2009	Solution Growth and Comparative Characterization of L-HFB Single Crystals.	Cryst. Res. Technol. 44, 167-172 (2009).	Nidhi Sinha, Sahas, B.K. Singh, N. Singh, K. Kumar, M.K. Gupta, G.C. Budakoti
(1) 2009	Ferroelectricity in glycine picrate: An astonishing observation in a centrosymmetric crystal”	Applied Physics Letters, 95, 252902:1-3, (2009).	M. Shakir, B. K. Singh, G. Bhagavannarayana.

#### 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. Bdkin and G.C. Trigunayat. In: Superconductivity Research Horizons, Ed: E.H. Peterson, Nova Science Publisher, Inc, USA, p. 71-110 (2007).

**Reviewed** more than 15 submitted papers in Journals like Nano Scale, J of Crystal Growth, Materials Letters, Materials Research Bulletin, Science of Advanced Materials, Materials Science and Engineering, etc.

**Ph.D. Supervision:** Six students received Ph.D. Degree in the Past three years; Six are currently registered as Ph.D. student. Examiner of more than ten Ph.D. thesis and conducted Ph.D. viva voce of over six Ph.D. students of other Universities in the past three years.

Sr. No.	Name of Student	Ph.D. Tenure	Ph.D. Thesis Title
6.	Neeti Goel	Sept, 2009- Oct, 2012	“Structural, thermal, optical & dielectric characterization of solution grown pure and doped semi organic sodium phthalate single crystals”
5.	Satya Kumar Khushwaha	Sept, 2008- 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”

4.	Manoj Kumar Gupta	March, 2008- June, 2011	“Growth of Doped and Undoped ZnO Nanostructure & their Morphological, Structural, Optical, Dielectric and Piezoelectric Characterization”
3.	Neelam Singh	Sept,2006- June, 2011	“Structural, Optical And Dielectric Characterization of Solution grown Organic/Semi Organic Single Crystals”
2.	Krishan Kumar	Oct, 2005 – Oct, 2010	“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”
1.	Budhendra Kumar Singh	Sept, 2005- March, 2010	“Structural, Piezoelectric, Dielectric, Optical and Electrical Characterization 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> Single Crystal”

### Collaborators:

1. Dr. G. Bhagavannarayan, National Physical Laboratory, Delhi
2. Prof. P. Ramasamy, Dean Research, SSN College of Engineering, Chennai
3. Prof. R. Dhanasekaran, Crystal Growth Center, Anna University
4. Prof. S. Moorthybabu, Crystal Growth Center, Anna University
5. Dr. Vijayan, National Physical Laboratory, Delhi
6. Prof. Igor Bdkin and Prof. Kolkhin, Aveiro University, Portugal

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

(2009-12 only)

- [1] **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 nanogenerator applications of ZnO nanocrystals” **International Advisory Committee member and Chairing a Technical Session on Nano-Energy.**
- [2] **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.
- [3] **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.**
- [4] **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.**
- [5] **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.**
- [6] **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 – TamilNadu
- [7] **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.
- [8] **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.
- [9] **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.
- [10] **Five papers** are presented in “The 17th American Conference on Crystal Growth and Epitaxy (9-14 August, 2009) at Lake Geneva,

**Wisconsin, USA”.**

- [11] **Invited Talk** “Pb-based and Pb-free piezoelectric systems for high performance applications” in International Conference on Electroceramics, Delhi 13-17 Dec. 2009.
- [12] **Invited Talk** “Development of high performance piezoelectric single crystals for applications” at Variable Energy Cyclotron Center, Kolkata, 18<sup>th</sup> June 09.
- [13] **Invited Talk** “High performance piezoelectric crystals: Growth, Characterization and Applications” in National Conference on Advanced Materials – Processing, Characterization and Applications. Tirunelveli, Tamilnadu, Aug. 09.
- [14] **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.
- [15] **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.
- [16] **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.
- [17] **Invited Talk** “High performance piezoelectric crystals: Growth, Characterization and Applications” in National Conference on Advanced Materials – Processing, Characterization and Applications. Tirunelveli, Tamilnadu, Aug.09.
- [18] **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”.
- [19] **Four contributory papers** in “The 38<sup>th</sup> National Seminar on Crystallography, University of Mysore, 11-13 February 2009.

**Total Publication Profile optional**

**Books : One**

**In Indexed/ Peer Reviewed Journals: Sixty Five**

**Review Articles : One**

**Conference Presentations : Over 25 in 2009-11**

**Public Service / University Service / Consulting Activity:** Served as a member of various academic bodies like Faculty of Science, BRS, Dy Superintendent of Exams, etc.; Examiner for nearly ten Ph.D. Thesis of other Universities during 2009-12

**Professional Societies Memberships**

1. Indian Crystallographic Association
2. Semiconductor Society of India
3. Indian association of Physics Teachers
4. Electron Microscopic Society of India

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

1. Principal Investigator, UGC Project “Growth and characterization of n- and p-type ZnO nanostructure for optoelectronic applications” 2012-15 (7.6 lac).
2. Principal Investigator, DST Project ”Growth of Device Level Lead free Alkali-Based Piezoelectric Single Crystals” 2011-14 (25 Lac)
3. Principal Investigator, DST Project “Synthesis of High Performance Piezoelectric Ceramic & Crystals for Device Fabrication” 2007-11 (46 Lac).
4. Principal Investigator “Growth of Device Level Non Linear Optical Organic/Semi- Organic Single Crystals By Various Methods” (2009-2012); PURSE Grant; 35 lacs.
5. Received financial support (2.5 Lac) four times during 2009-2011 for research work from Delhi University.

Organized a “National Conference on Advances in Technologically Important Crystals (NC-ATIC) during 12-14 October, 2006 in the Department of Physics & Astrophysics, University of Delhi, Delhi-110007

(Signature of Faculty Member)

(Signature & Stamp of HOD)