INDIAN ASSOCIATION FOR CRYSTAL GROWTH

January 2013 | Issue 25








IACG NEWS LETTER

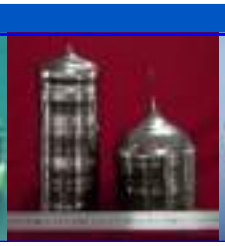
In this Issue










SANKARANARAYANAN-RAMASAMY (SR) METHOD GROWN CRYSTALS

Sodium Sulfanilate Dihydrate-
M.Senthil Pandian et. al, SSNCE

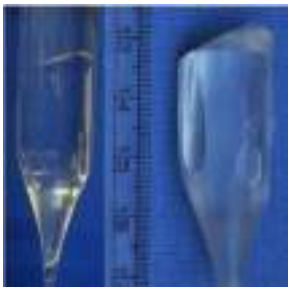
LCH-Dr.Sunil
Verma, RRCAT

L-LLDN-Dr.R.Ramesh
Babu et. al, BU

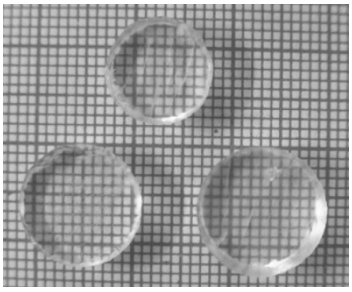
LTA-K. Moovendran
et. al, MKU

ADP-Dr.P.Rajesh et. al,
CCG, SSNCE

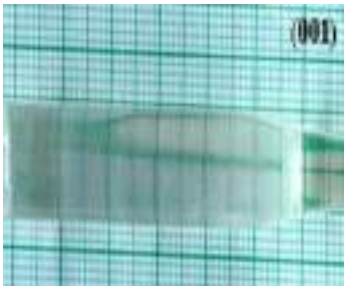
(010) Face TGS – Dr.K.B.R.Varma
et. al, IISc, Bangalore



LPCCM-
Dr.G.Bhagavannarayana, NPL

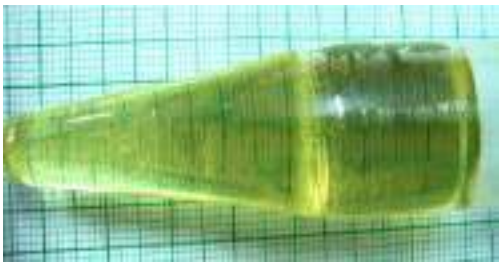


BTCA-Prof.K.Kishan Rao,
Kakatiya Univ, Warangal

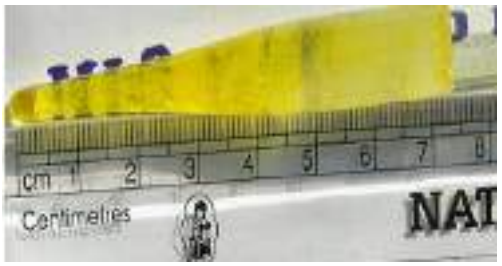


LAHCl-Dr.K.Sangeetha
et.al, BU, Trichy

<110> directed ADP crystal-
Dr.K.Sethuraman et. al, MKU

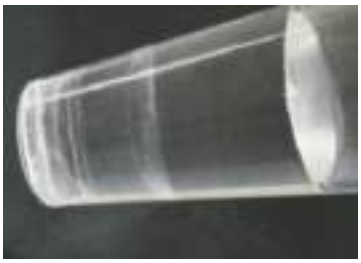


Benzil - Dr.M.Rajalakshmi et.al, CRL, Dept.
of Physics, Anna University, Chennai



BBPNPN - Dr.S.Jerome Das et. al,
Loyola College, Chennai

UGPI-Dr.S.Kalainathan
et. al, VIT, Vellore

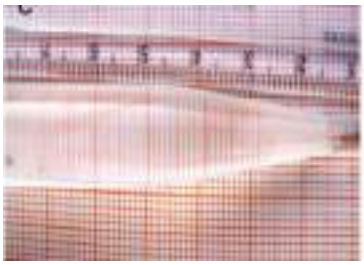


LAM- Dr.C.Urit Chareon-In
et. al, Thailand

KDP-Dr.N.Balamurugan et. al,
Centre for Crystal Growth, SSNCE

HA-Dr.N.Vijayan, et. al,
NPL, New Delhi

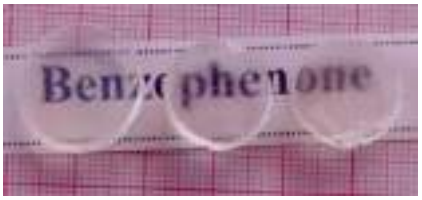
Mixed $NaCl_{0.98}Br_{0.02}O_3$-
Jingran Su et. al, China



SrLM-Dr.A.Senthil et. al,
SRM University

$NiSO_4$-Dr.H.Rezagholipour
Diazji, Iran

Diglycine Zinc Chloride Dihydrate-
M.Senthil Pandian et. al, SSNCE



BP-Dr.K.Sankaranarayanan et. al,
Alagappa Univ, Karaikudi

ZTS-Dr.J.Thomas Joseph Prakash -
H.H. The Rajah's College, Puthukottai

1, 2 and 3 Mol% L-arginine doped KDP-
Dr.N.Pattanboonmee et. al, Thailand

Editorial

First Indian Seminar on Crystal Growth,

Crystal Growth Centre, Anna University, Chennai, October 4-6, 1982
Progress in Crystal Growth and Characterizations, Vol.6, 1983, Page i-ii

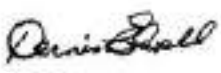
In October I had the pleasure of visiting India to attend the first **National Seminar on Crystal Growth at Anna University, Madras**. Traditionally talks on crystal growth in India have been presented at meetings on Crystallography and there was inevitably some opposition to breaking this link with crystallography, but the Seminar was well supported. 125 delegates attended and 80 papers were presented in a single-session conference or in poster sessions. The conference revealed much of the strengths and weaknesses of crystal growth in India, although I did see some excellent work which was not presented there. Crystal growers are Indian Universities are often poorly funded, apart from established groups such as those at Sadar Patel and Benaras Hindu Universities. Most researchers are constrained in their choice of topics to those which require only a modest investment in equipment and materials. Apparatus for characterization is often very limited. Some useful work is done in spite of these handicaps, the most successful university groups probably being those which collaborate with government or Indian Institute of Technology laboratories which are generally well equipped.

Of the ten review talks presented at the conference, the most interesting for me was the description by **Dr. Krishan Lal** (National Physical Laboratory, Delhi) of experiments aimed at growing highly perfect alkali halide crystals and particularly of their characterization by multi-crystal X-ray diffractometry. High-resolution diffuse X-ray scattering is a relatively little-used technique which can give valuable information on, for example, point-defect aggregation in silicon, a very important topic in which definitive experiments are very difficult. In general, the conference was disappointing in the scarcity of papers on important materials. Exceptions included reviews of dislocation-free silicon crystal growth by **R. K. Bagai** (Solid State Physics Laboratory, Delhi), and melt growth of oxides by **R. Thyagarajan** (Defence Science Center, Delhi). Reference has been made in the scientific press to India's emerging semiconductor industry, but these developments were not mentioned at the conference.

My general feeling was that the considerable talents in the Indian crystal growth community, particularly the universities, could be better used if more collaborative projects were arranged with more generous laboratories in the U.S.A. Europe or Japan. Modelling studies, property measurements (e.g., viscosity) for systems of current interest and experiments to test fundamental theories and assumptions are all important areas which are often neglected in crystal growth laboratories because of contract or production requirements only to grow the crystals. Indian academics could make a big impact on crystal growth if their energies were more focused on "relevant“ problems.

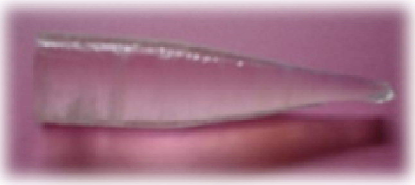
Dr. P. Ramasamy, Convener of the conference, is to be congratulated on his initiative and on his success in having his laboratory designated as a **"Crystal Growth Center"**, with funding set aside for a purpose-built building with improved staffing and equipment. The Center already has 20 graduate students and has had an impressive range of papers on crystal growth accepted by International Journals over the last 2 or 3 years.

Finally, the Seminar included a lively discussion on the desirability of an Indian Association for Crystal Growth. An ad hoc committee was formed and **Drs. P. Ramasamy and S. Murali D. Rao (Bhabha Atomic Research Center),** were charged with the compilation of a provisional membership list. Maybe ICCG 9 or 10 will be held in India?.



Prof.Dennis Elwell
Associate Editor,
Progress in Crystal growth and Characterizations

SANKARANARAYANAN-RAMASAMY (SR) METHOD

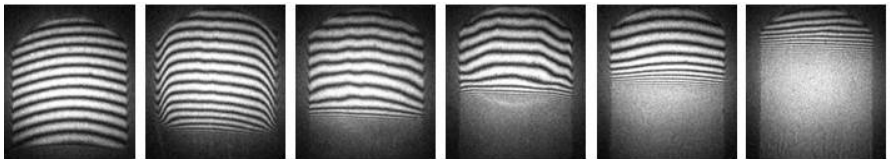


World's first unidirectional method grown crystal from solution - 2004 K. Sankaranarayanan et. al.

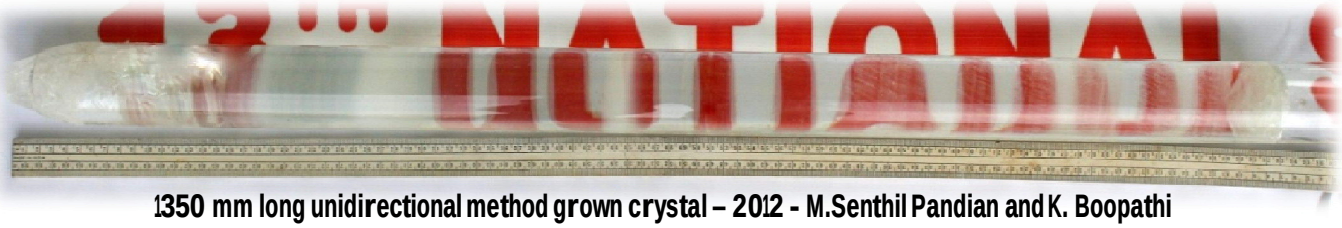
- **110 papers** have so far appeared in International Journals.
- **22 Journals** have published SR method papers.
- **8 projects** have been funded (BRNS, DST, AICTE, UGC, CSIR).
- Several laboratories in India and abroad are growing crystals by SR method.

650 mm long unidirectional method grown crystal – 2008 M. Arivanandhan et. al.

In situ and real time optical imaging of convection, concentration profiles, growth rate and solutal boundary layer thickness has been performed during unidirectional crystal growth process at **Dr.Sunil Verma's laboratory, LMDDD, RRCAT, Indore**. Special growth apparatus was designed and fabricated for imaging studies. It is shown that gravity driven driving force is responsible for the growth of crystal in unidirectional growth from solution.



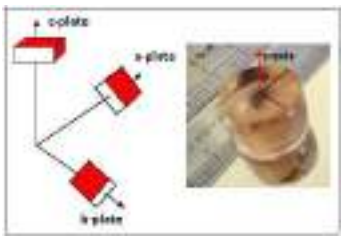
Time lapsed images of gravity driven concentration field during unidirectional crystal growth as observed by Mach-Zehnder interferometry in wedge fringe

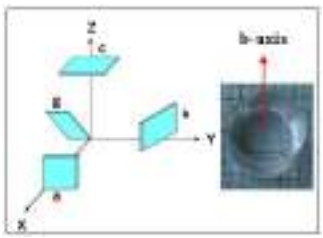


1350 mm long unidirectional method grown crystal – 2012 - M.Senthil Pandian and K. Boopathi

Dielectric Tensor Components for Unidirectional method grown Monoclinic and Orthorhombic crystals

The dielectric permittivity of a crystalline material is a second rank tensor. For an orthorhombic system there are three independent components: ε_{11}, ε_{22} and ε_{33} corresponding to a, b and c-directions respectively. Anisotropy in the dielectric behavior has been observed. The dielectric tensor components of SR grown SSDH were measured and found to be ε_{11}=12.25, ε_{22}=9.501, ε_{33}=8.55. For a monoclinic system there are four independent components. The four dielectric tensor components of SR method grown GPI were measured and found to be ε_{11}=8.50, ε_{22}=10.2, ε_{33}=11.1, ε_{13}=-2.7.



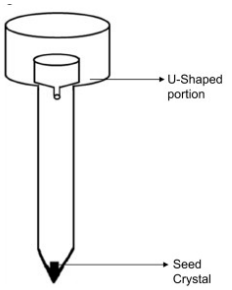


1. M.Senthil Pandian, N.Pattanaboonmee, P.Manyum, P.Ramasamy*, Journal of Crystal Growth, Vol.314, 2011, Pages.207-212.
2. M.Senthil Pandian, P.Ramasamy*, Materials Chemistry and Physics, Vol.132, 2012, Pages.1019-1028.

Negative solubility $Li_2SO_4.H_2O$ crystal by SR method

Single crystals of negatively soluble lithium sulphate monohydrate (LSMH) have been grown by unidirectional method. The grown crystal is shown in the Figure.

Unidirectional method grown $Li_2SO_4.H_2O$ crystal



Photograph of the modified glass ampoule used for LSMH crystal growth by SR method

K.Boopathi, P.Rajesh, P.Ramasamy*, Journal of Crystal Growth, Vol.345, 2012, Pages.1-6.

CHARACTERIZATION AVAILABILITY

FTIR and UV-Vis NIR Spectrum

Prof. P. Ramasamy, President-IACG,
Dean (Research),
SSN College of Engineering
Chennai 603 110, Tamilnadu
Email: ramasamyp@ssn.edu.in

High Resolution X-ray Diffraction

Prof. G. Bhagavannarayana, Head,
Materials Characterization Division,
National Physical Laboratory (CSIR),
New Delhi 110 012,
Email: bhagavan@nplindia.org

P-E Hysteresis and d_{33} coefficient

Prof. Binay Kumar,
Crystal Lab, Department of Physics and
Astro Physics, University of Delhi,
New Delhi 110 007,
Email: bkumar@physics.du.ac.in

Single Crystal X-ray Diffraction

Prof. D. Velmurugan, Head,
Department of Crystallography and
Biophysics, University of Madras,
Chennai 600 025, Tamilnadu
Email: dvelmurugan@unom.ac.in

Laser Damage Threshold

Prof. S. Kalainathan, Deputy Director,
Centre for Crystal Growth
Vellore Institute of Technology
University, Vellore 632 014, Tamilnadu
Email: kalainathan@yahoo.com

Vickers Microhardness

Dr. R. Gopalakrishnan, Associate
Professor, Crystal Research Laboratory,
Department of Physics, Anna University,
Chennai 600 025, Tamilnadu
Email: krgkrishnan@annauniv.edu

Powder X-ray Diffraction

Prof.C.Sangeeviraja,
Chair Person and Head, School of
Physics, Alagappa University,
Karaikudi 630 003
Email: sanjeeviraja@rediffmail.com

Optical Imaging and Birefringence

Dr. Sunil Verma, Scientific Officer-F,
Laser Materials Development Devices
and Division, RRCAT,
Indore 452 013, Madhya Pradesh,
Email: sverma1118@gmail.com

Dielectrics and Hall Effect

Dr. R. Ramesh Babu, Assistant
Professor, Department of Physics,
Bharathidasan University,
Tiruchirappalli 620 024, Tamilnadu,
Email: rampap2k@yahoo.co.in

Refractive Index

Prof. D. Rajan Babu,
Department of Physics,
Vellore Institute of Technology
University, Vellore 632 014, Tamilnadu
Email: drajanbabu@vit.ac.in

Photo Luminescence (PL)

Dr. U. Madhusoodanan, Scientist,
Radiation Safety Division, Indira Gandhi
Centre for Advanced Research,
Kalpakkam 603 102, Tamilnadu,
Email: ums@igcar.gov.in

Second Harmonic Generation

Prof. P. Ramamurthi, Director,
National Centre for Ultrafast Process,
University of Madras,
Taramani Campus, Chennai
Email: murthy@unom.ac.in

BEST PAPER AWARDS

M.Senthil Pandian, Centre for Crystal Growth, SSNCE received **BEST ORAL PRESENTATION AWARD** in the XVI National Seminar on Crystal Growth held at Aditanar College of Arts and Science, Tiruchendur, 19-21 January 2012

M.Moovendran, School of Physics, Madurai Kamaraj University received **BEST ORAL PRESENTAION AWARD** in the National Conference on Physics of New Materials, Noorul Islam University, during 20-21 April 2012

Pooja Seth, GGSI University, Delhi received **BEST ORAL PRESENTAION AWARD** in the XV National Seminar on Crystal Growth, PSNCET during 23-25 February 2011

Dr.K.Sangeetha, Bharathidasan University received **BEST ORAL PRESENTAION AWARD** in the XV National Seminar on Crystal Growth, PSNCET, Tirunelveli during 23-25 February 2011

K.Boopathi, Centre for Crystal Growth, SSNCE received **BEST CRYSTAL PRESENTAION AWARD** in the XV National Seminar on Crystal Growth, PSNCET, Tirunelveli during 23-25 February 2011

P.Kannappan, Crystal Growth Centre, Anna University received **BEST POSTER AWARD** in the XV National Seminar on Crystal Growth, PSNCET, Tirunelveli during 23-25 February 2011

YOUNG RESEARCHERS FORUM

Crystal display in VIT University presented by **Centre for Crystal Growth, SSNCE** in XIV National Seminar on Crystal Growth, VIT University, Vellore during March 10-12, 2010

Annual Workshop on Advanced Materials 2012 in PSN College of Engineering and Technology, Tirunelveli

Crystal display in PSN College of Engg., presented by **Centre for Crystal Growth, SSNCE** in II National Conference on Advanced Materials, Tirunelveli during August 25-27, 2010

Dr.P.K.Gupta, RRCAT, Indore with the members of SERC School on Laser physics and Technology (March 12-30, 2012)

Bharat Jyoti Award

Dr. N. Vijayan, Scientist -D, NPL, New Delhi was awarded "**Bharat Jyoti Award"** in 2011. This award was given by India International Friendship Society.

PATENT FILED

Inventors:
Dr.G.Anandha Babu
Prof.P.Ramasamy
Centre for Crystal Growth, SSNCE

Title: Growth of an efficient nonlinear optical D-Π-A- Π-D type benzophenone derivative crystal". **[1005/CHE/2009 30-4-2009]**

Dr.D.S. Kothari Post Doctoral Fellowship

Dr. Mohd. Shkir has been awarded Dr.D.S. Kothari Post Doctoral Fellowship, 2012. He was guided by Prof. M.A. Wahab and Prof. G. Bhagavannarayanana.

He is now working under Prof. P. D. Sahare, Dept. of Physics, University of Delhi, New Delhi in Organic NLO crystals using CZ techniques.

Recipients of IACG "PROF.P.RAMASAMY National Award for Crystal Growth"

Year	Recipient(s)
2000	**Dr. P. Santhana Raghavan**, GT Solar Corporation Limited, USA. **Dr. G. Dhanaraj**, Chief Scientist, Crystal Growth Technologies at ARC Energy, Nashua, USA
2002	**Prof. R. Dhanasekaran**, Crystal Growth Centre, Anna University, Chennai.
2003	**Prof. M. Ichimura**, Dept. of Electrical & Electronic Engineering, Nagoya Institute of Technology, Japan.
2004	**Dr. K. Sankaranarayanan**, Department of Physics, Alagappa University, Karaikudi.
2005	**Dr. R. Gopalakrishnan**, Crystal Research Laboratory, Department of Physics, Anna University, Chennai.
2006	**Prof. C. K. Mahadevan**, Physics Research Centre, Department of Physics, S.T. Hindu College, Nagercoil.
2007	**Dr. N. Vijayan**, Scientist, X-ray analysis & Crystal Growth Section, National Physical Laboratory, New Delhi.
2008	**Prof. S. Moorthy Babu**, Crystal Growth Centre, Anna University, Chennai.
2009	**Prof. K. Ramamurthi**, Department of Physics, Bharathidasan University, Trichirappalli. **Dr. S. Ganesa Moorthy**, Scientist-F, Laser Materials Development Devices & Division, RRCAT, Indore.
2010	**Prof.G. Bhagavannarayana**, Chief Scientist & Head, Crystal Growth & X-ray analysis sec., NPL, New Delhi. **Prof. S. Kalainathan**, Deputy Director, Centre for Crystal Growth, VIT University, Vellore.

On 26th Sept. 2012, CSIR celebrated its 70th birth day. On this auspicious occasion, a book was released by the Prime minister which contains 70 selected outstanding scientific articles published in this 70 years long duration on the basis of impact factor, total citations and citations per year by the scientists of all CSIR labs (37) in all areas. In this selected list, the following two papers which belongs to characterization of bulk single crystals took their respective places.

1. A high resolution diffuse X-ray scattering study of defects in dislocation free silicon crystals grown by the Float zone method and comparison with the Czochralski grown crystals.
Krishan Lal and G. Bhagavannarayana, J. Appl. Cryst. 22, 209-215 (1989).
2. A Study of Effect of Annealing on Fe-doped LiNbO3 by HRXRD, XRT and FTIR
G.Bhagavannarayana, R.V.Ananthamurthy, G.C.Budakoti, B.Kumar, K.S.Bartwal, J. Appl. Cryst. 38, 768-771(2005).

PATENT FILED

Inventors: **Dr.T. Prem Kumar**
Dr. K. Sankaranarayanan
(Dept. of Physics, Alagappa University, Karaikudi)
Prof. P. Ramasamy
(Centre for Crystal Growth, SSNCE, Chennai)

Title: Blue emitting $CU_XCd_{X-Y}S_Y$ (x~0.5 and y~0.15) material: Synthesis and depostion of thin films by Chemical bath depostion and its optical devices
[693/CHE/2010 16-03-2010]

Dr.C.K.Mahadevan, Physics Research Centre, Department of Physics, S.T.Hindu College, Nagercoil has received the **Life Time Achiever's Award** from the Scott Alumni Association on May 01, 2012.

Books by Prof.Rajnikant

Title: Applied Solid State Physics
Author: Rajnikant **Year:** 2011
Publisher: John Wiley & Sons

Title: Polymorphism and Multiple Molecule X-ray Structure of some Biphenyls
Author: Rajnikant, Vivek Gupta, Ahsan Elahi
Year: 2012
Publisher: Lambert Academic Publications

LIST OF JOURNALS WITH IMPACT FACTOR-2012

Journal Name	IF
Advanced Functional Materials	**10.17**
Advanced Optical Materials	**10.88**
Applied Surface Science	**2.103**
Applied Physics A : Materials Science and Processing	**1.630**
Bulletin of Materials Science	**0.88**
Chinese Science Bulletin	**1.321**
Crystal Growth and Design	**4.72**
Crystal Engineering Communication	**4.00**
Crystal Research and Technology	**0.946**
Current Applied Physics	**1.900**
Ferroelectrics	**0.391**
Japanese Journal of Applied Physics	**1.058**
Journal of Crystal Growth	**1.726**
Journal of Applied Crystallography	**5.15**
Journal of Alloys and Compounds	**2.289**
Journal of Physics and Chemistry of Solids	**1.632**
Journal of Physics D: Applied Physics	**2.544**
Journal of Solid State Chemistry	**2.159**
Journal of Physics: Condensed Matter	**2.546**
Journal of Materials Chemistry	**5.97**
Journal of Materials Science and Technology	**0.738**
Journal of Materials Science: Materials in Electronics	**1.076**

Journal Name	IF
Journal of Thermal Analysis and Calorimetry	**1.604**
Materials Letters	**2.307**
Materials Chemistry and Physics	**2.234**
Materials Research and Bulletin	**2.105**
Materials Science and Engineering A	**2.003**
Materials Science and Engineering B	**1.518**
Materials Characterizations	**1.572**
New Journal of Chemistry	**3.006**
Optical Materials	**2.023**
Optics Communications	**1.486**
Optics and Laser Technology	**1.515**
Optik- International Journal for Light and Electron Optics	**0.510**
Progress in Crystal Growth and Characterization of Materials	**5.750**
Physica B:Condensed Matter	**1.063**
Science of Advanced Materials	**3.308**
Solid State Communications	**1.649**
Solid State Science	**1.856**
Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy	**2.098**
Surface Science Letters	**1.994**
Synthetic Metals	**1.829**
Nuclear Instruments and Methods in Physics Research Section: B	**1.211**
The European Physical Journal of Applied Physics	**0.756**

CONFERENCE HIGHLIGHTS

XVI National Seminar on Crystal Growth (NSCG), January 19-21, 2012
(Sponsored by DRDO, BRNS, TNSCST, IACG)

Department of Physics, Aditanar College of Arts and Science, Tiruchendur 628 216, Tamilnadu.

"XVI National Seminar on Crystal Growth (NSCG 2012)" was held during 19-21st January 2012 at Department of Physics, Aditanar College of Arts and Science, Tiruchendur, Tamilnadu. **Dr.P.Selvarajan** organized this conference. Inaugural address was delivered by Prof.P. Ramasamy, President, IACG. Dr.B. Annadurai, HOD, Department of Physics, Aditanar College of Arts and Science gave the welcome address. The nicely arranged inaugural function concluded with vote of thanks by Dr.P. Selvarajan, Convener, NSCG. There were 37 invited talks and 144 contributed papers. More than 150 participants from all over India participated and presented papers in this conference. The conference covered various aspects of crystal growth and also focused on the synthesis and characterization to a great extent.

There was a panel discussion and many participants took active part in the deliberations. Dr.P. Selvarajan had made very elaborate arrangements and ensured great success for the programme. The college authorities and the faculty members were deeply involving in a variety of ways. The following papers were selected for best paper award.

I-Prize Growth of $LiKB_4O_7$ single crystal by Czocharalski method
M. Sukumar, R. Ramesh Babu, K. Ramammurthi

II-Prize A comparative investigation of (010) ferroelectric triglycine sulphate (TGS) crystals grown by conventional and SR method
M. Senthil Pandian, Sunil Verma, P. Ramasamy

III-Prize Synthesis, growth, thermal optical and mechanical properties of 2-aminopyridinium 4-methylbenzoate dihydrate
M. Rajalakshmi, R. Indirajith, M. Palanichamy, R. Gopalakrishnan

IV-Prize Simultaneous growth of several materials using a single experimental setup
S. Natarajan, **K. Moovendran**

The **BEST PAPER** awards were sponsored by **Indian Association for Crystal Growth (IACG)**.

The final session was dedicated for panel discussion. Dr.P.Selvarajan's hard work was responsible for the great success of the conference.

N. Karunagaran, M. Senthil Pandian
Centre for Crystal Growth, SSN College of Engineering, Chennai

CONFERENCE HIGHLIGHTS

International Conference on Recent Trends in Advanced Materials (ICRAM 2012), February 20-22, 2012

School of Advanced Sciences, VIT University, Vellore 632 014, Tamilnadu

Materials play a major role in shaping our understanding of nature. The fact that we identify human civilization by materials (Stone Age, Bronze Age, Iron Age, and Silicon Age) confirms the importance of materials in the progress of society. Social and economic developments depend, to a large extent, on materials. Development of new and advanced materials, and material processes is critical to a nation's economy. Advanced materials offer exceptional properties enabling engineers to design novel and high quality products. Challenges relating to energy, resources and environment continue to haunt us. A proper understanding and the appropriate use of right materials can alleviate these challenges to a large extent.

With this objective, an International Conference on Recent Trends in Advanced Materials (ICRAM-2012) was organized at VIT University, India, during 20-22, February 2012 where experts and scholars shared their knowledge on the major topics such as nano, ferroelectric, magnetic, meta, polymer, non linear optical, composite, thermoelectric, bio, catalytic–inorganic, semiconductor and superconducting materials. Key note addresses, plenary talks, Invited lectures, oral and poster presentations were organized for dissemination of knowledge. Eminent scientists and experts from Japan, Spain, Slovakia, France, Czech Republic, Singapore, United Kingdom, Korea, Ireland, Germany, Switzerland and India conducted technical sessions. Two plenary and thirty-three invited lectures, and sixty-three oral presentations were arranged as part of the conference. 400 research papers were presented in the poster sessions.

We received 285 full-length research articles from the registered participants. A team of sixty-five eminent scientists from various institutions carefully reviewed the papers. Of these, one hundred and thirteen papers have been accepted for favour of publication in Advanced Materials Research, Trans Tech Publication, Switzerland. Out of which 32 articles are related with Crystal Growth and Characterization.

I am grateful to the Chancellor, Vice Presidents, Vice Chancellor, Pro Vice-Chancellors, the Director, School of Advanced Sciences and the Director, School of Social Sciences and Languages of VIT University for their encouragement, help, guidance and support. I thank the keynote, plenary, and invited speakers, and the delegates for their contribution to this book. I express my gratitude to the Department of Science and Technology, Defence Research & Development Organization, Council of Scientific and Industrial Research, Board of Research in Nuclear Sciences (DAE) and the Ministry of Earth Sciences, New Delhi and other private organizations for their generous funding for this conference.

I thank the speakers, reviewers, participants, the committee members, chair and co-chairpersons, students and volunteers who contributed to the success of ICRAM-2012.

Prof. D. Rajan Babu
Convener - ICRAM2012
School of Advanced Sciences
VIT University, Vellore

VIT UNIVERSITY
(Estd. u/s 3 of UGC Act 1956)

CRYSTAL RELATED DISCOVERIES

YEAR	INVENTOR	INVENTION
1556	Agricola	Production of various salts
1611	Kepler	Structure of snow crystals
1665	Hooke	Structure of Crystals
1669	Bartholinus	Birefringence of calcite crystals
1690	Huygens	Structural interpretation of Birefringence
1795	Lowitz	Supersaturation and crystallization of salt solutions
1815	Weiss	Crystal systems
1822	Mitscherlich	Polymorphism
1824	Seeber	Lattice structure of crystals
1830	Hessel	Crystal classes
1837	Gaudin	Ruby from high temperature solution
1839	Miller	Miller Indices
1849	Bravais	Lattice types and crystal forms
1851	Durocher	Vapor growth of sulphide crystals
1865	Gernez	Reciprocal pairs of salts
1865	Marangoni	Liquid surface phenomena
1872	De Coppet	Spontaneous nucleation
1878	Gibbs	Heterogeneous phase equilibrium
1880	Hannay	Man made diamonds

YEAR	INVENTOR (S)	INVENTION
1885	Curie	Minimum surface energy of growth forms
1891	Federov	Space groups
1893	Ostwald	Metastable region of supersaturation
1898	Tammann	Measurements of nucleation and growth rates
1900	Ostwald	Dependence of solubility on particle size
1904	Nernst, Brunner	Diffusion layer on a crystal surface
1905	Spezia	Hydrothermal synthesis of quartz
1912	Laue, Friedrich	X-ray diffraction by crystals
1913	Bragg	X-ray structure analysis
1922	Volmer	Adsorption and surface diffusion processes
1926	Volmer, Weber	Thermodynamic theory of nucleation
1927	Kossel	Half crystal position
1928	Stranski	Detachment energy
1935	Becker, Doring	Kinetic theory of nucleation
1937	Donnay	Morphological aspect
1949	Burton, Cabrera, Frank	Spiral growth (BCF theory)
1953	Rutter, Chalmers	Constitutional supercooling
1953	Burton, Prism	Effective distribution coefficient
1955	Hartmann	PBC Vectors

Reference : R.S.Feigelson, 50 Years Progress in Crystal Growth, Elsevier, Netherlands, 2004

INVENTION OF CRYSTAL GROWTH METHODS

Year	Method	Inventor(s)	Original aim
1851	**Hydrothermal**	**De Senarmont**	Growth of low temperature polymorphs of refractory materials [SiO_2, α-Quartz]
1902	**Verneuil**	**A.V.L. Verneuil**	Growth of crystals without crucible [Ruby, Sapphire]
1917	**Czochralski**	**Czochralski**	Investigations on the rate of crystallization of metals
1924	**Bridgman**	**Obereimov, Schubnikov**	Growth of metal crystals [Bi, Sn, Zn, Mg, Al, Cu]
1925		**Bridgman**	Growth of metal crystals [W, Sb, Bi, Te, Zn, Sn]
1925		**Stober**	Growth of $NaNO_3$, Bi and Zn crystals
1936		**Stockbarger**	Growth of alkali halide crystals [KBr, LiF]
1916	**Nacken-Kyropoulos**	**Nacken**	Growth of Salol and benzophenone crystals
1926		**Kyropoulos**	Growth of alkali halide crystals
1926	**Gel growth**	**Liesegang**	Controlled diffusion and the growth process is free from convection [Hippuric acid, PbI_2, $PbCl_2$]
1928	**Zone melting in crucible**	**Kapitza**	Purification and crystal growth of Bi
1952		**Pfann**	Purification of Ge
1953	**Floating zone**	**Keck, Golay**	Purification of Si
1954		**Emeis**	Purification of Si
1969	**Petrov crystallization**	**T.G. Petrov**	Growth of relatively high solubility materials [Rochellesalt, KDP, ADP]
1970	**Skull melting**	**Aleksandrov, Osiko, Tatarinstev**	Growth of high melting point materials [Zirconium oxide]
1971	**Robertson**	**D.S. Robertson**	Growth of crystals from aqueous solution by the Bridgman technique [TGS, $MgSo_4$]
1975	**Flux growth**	**Elwell and Scheel**	Growth of crystals grown from different fluxes [KTP]
2005	**Unidirectional solution-crystallization**	**K.Sankaranar-ayanan, P.Ramasamy**	Good quality bulk organic, inorganic and semiorganic single crystals along a specific orientation [KDP, ADP, LAP, ZTS, TGS, L-LMHCl, GPI etc.,]

CRYSTAL GROWTH PROJECTS

Dr. G. Anandha Babu, Assistant Professor, Department of Physics, SSN college of Engineering, Chennai 603 110, Tamilnadu
Co-PI: Prof.P. Ramasamy, Dean (Research), SSN College of Engineering, Chennai

Project Title : Crystal growth of Ce based alkali halides scintillator crystals and their characterization
Funding Agency : BRNS **Year :** 2011-2013 **Amount :** Rs. 22.00 lakhs

Project Title : Crystal growth of lead free piezoelectric crystal $[Bi_{0.5}(Na_{1-X}K_X)_{0.5}]$ TiO_3 by flux technique and its characterization
Funding Agency : DST **Year :** 2011-2013 **Amount :** Rs. 19.00 lakhs

Dr. R. Arun Kumar, Assistant Professor, Department of Physics, PSG College of Technology, Coimbatore 641 004, Tamilnadu

Project Title : Growth and Characterization of rare earth borate-based single crystals for UV laser generation
Funding Agency : DST-SERB
Year : 2012-2015
Amount : Rs. 49,33,600

Dr. R. Gopalakrishnan, Associate Professor, Crystal Research Lab, Department of Physics, Anna University, Chennai 600 025, Tamilnadu

Project Title : Synthesis, growth and characterization of picrate family crystals and growth of potassium sodium tartrate tetrahydrate single crystals from conventional solution growth and unidirectional growth method of Sankaranarayanan-Ramasamy for technological applications
Funding Agency : Council of Scientific and Industrial Research (CSIR)
Year : 2010-2013 **Amount :** Rs. 16,71,000

Prof. S. Kalainathan, Deputy Director, Centre for Crystal Growth, VIT University, Vellore 632 014, Tamilnadu

Project Title : Growth and Characterization Of New Nonlinear Optical Stilbazolium crystal 4 – N,N-dimethylamino - 4`- N` -methyl-stilbazolium-2 napthalenesulfonate
Funding Agency : DRDO **Year :** 2012-2015 **Amount :** Rs. 22.62 lakhs

Project Title : Growth and Characterisation of Lead Sulfide doped on maganese, Europium and Gadolinium to thermal, Structural, Mechanical and Microhardness using Bridgeman Method
Funding Agency : CSIR **Year :** 2012-2015 **Amount :** Rs. 17.80 lakhs

Project Title : Growth and Characterization of oxide single crystals using optical floating zone technique
Funding Agency : UGC-DAE **Year :** 2012-2015 **Amount :** Rs. 6.59 lakhs

Dr. P. Rajesh, Assistant Professor, Department of Physics, SSN College of Engineering, Chennai 603 110, Tamilnadu
Co-PI : Prof.P.Ramasamy, Dean (Research), SSN College of Engineering, Chennai

Project Title : Development of high quality direction controlled lithium iodate and lithium sulphate single crystal for nonlinear optical applications
Funding Agency : BRNS
Year : 2012-2015
Amount : Rs. 23,00,000

Prof. K. Ramamurthi, Department of Physics, Bharathidasan University, Tiruchirappalli 620 024, Tamilnadu

Project Title : Top seeded solution growth of $KNbO_3$ single crystals for nonlinear optical applications
Funding Agency : Department of Science and Technology (DST)
Year : 2011-2014
Amount : Rs. 12,26,200

Prof. P. Ramasamy, FNASc, Dean (Research), Centre for Crystal Growth, SSN College of Engineering, Chennai 603 110, Tamilnadu
Co-PI : Dr.G.Anandha Babu, Assistant Professor, Department of Physics, SSNCE

Project Title : Improved growth of lead-free piezoelectric single crystal $(Na_XBi_{1-X})TiO_3$-$BaTiO_3$ and characterization towards piezoelectric device applications
Funding Agency : Department of Science and Technology (DST)
Year : 2011-2013
Amount : Rs. 29,40,000

Project Title : Crystal growth of alkaline earth halide and cesium based alkaline earth halide scintillation crystals for gamma ray spectroscopy
Funding Agency : BRNS
Year : 2012-2015
Amount : Rs. 24,82,000

Dr. A. T. Ravichandran, Associate Professor, Department of Physics, The National College, Tiruchirapalli 620 001, Tamilnadu

Project Title : Bulk growth of Triglycine Sulphate (TGS) and Potassium Acid Phthalate (KAP) single crystals for device fabrication
Funding Agency : University Grants Commission **(**UGC)
Year : 2012-2015
Amount : Rs. 12,26,200

Dr. J. Thomas Joseph Prakash, Assistant Professor, Department of Physics, H.H.The Rajah's college, Pudukkottai 622 001, Tamilnadu

Project Title : Structural, Thermal, Photoacoustics, Dielectric and optical characterization of a semiorganic NLO crystal - Cadmium thiosemicarbazide bromide (CTSB), Cadmium thiosemicarbazide chloride (CTSC)
Funding Agency : University Grants Commission **(**UGC)
Year : 2012-2015
Amount : Rs. 9,53,800

FORTH-COMING EVENTS IN 2013

- **17th International Conference on Crystal Growth and Epitaxy (ICCGE-17), Warsaw, Poland, August 11-16th, 2013.**
  Web: science24.com/event/iccge17/

- **15th International Summer School on Crystal Growth, Gdansk, Poland, August 6-10th, 2013.**
  Web: http://science24.com/event/isscg15/

- **The 19th American Conference on Crystal Growth and Epitaxy (ACCGE-19), Keystone, Colorado, July 21-26th, 2013.**
  Web: http://www.crystalgrowth.org/KeystoneLodging.html

- **7th International Conference on Materials for Advanced Technologies (ICMAT-7), Singapore, 30th June -5th July 2013.**
  Web: http://www.mrs.org.sg/icmat2013/public.asp?page=home.asp

- **Third International Conference on Key Engineering Materials (ICKEM 2013) Kota Kinabalu, Malaysia, March 8-9th, 2013.**
  Web: http://www.ickem.org/

- **21st DAE BRNS National Laser Symposium (NLS-21), Bhabha Atomic Research Centre (BARC), Mumbai, February 6-9th, 2013.**
  Web: www.barc.gov.in/symposium/NLS-21/index.html

- **III National Conference on Advanced Materials-Processing, Characterizations and Applications, PSN College of Engineering and Technology, Tirunelveli, Tamilnadu, 23-25th January 2013. Web:** www.psnresearch.ac.in/news.html

- **8th International Conference on Advances in Metrology (AdMet 2013), National Physical Laboratory (NPL), New Delhi, February 21-23th 2013.**
  Web: www.admetindia.org/home

- **International Conference on Recent Trends in Applied Physics and Materials Science, Government College of Engineering and Technology, Rajasthan, February 1-2nd, 2013.**
  Web: www.ram2013.com

- **National Conference on Hierarchically Structured Materials (NCHSM 2013), Department of Physics, SRM University, Chennai, Tamilnadu January 24-25th, 2013.**

- **Third International Advances in Applied Physics and Materials Science Congress Limak Limra International Hotels & Resort Antalya, Turkey**
  Web: http://www.apmas2013.org/important.html **April 24-28th, 2013.**

- **Fourth International Conference on Material and Manufacturing Technology (ICMMT), Seoul, Korea Web:** http://www.icmmt.org/
  May 11-12th, 2013.

FELLOWSHIPS AVAILABLE IN INDIA

Prime Minister's Fellowship Scheme for Doctoral Research
100 fellowships every year starting from 2012. Duration: Maximum 4 years.
Areas of research: Science, Technology, Engineering, Agriculture and Medicine.
Stipend: The total fellowship amount will be Rs.6 Lakh per annum for a maximum period of four years.
Web: http://www.dst.gov.in/whats_new/whats_new12/pm-fellowship.pdf

CSIR-Nehru Science Post Doctoral Research Fellowship
Ph.D degree holders with in 3 years of award of Ph.D degree, or those who have submitted Ph.D theses. Applicants should have research publications in high impact factor SCI journals. Maximum age limit: 32 years.
Stipend: Rs.35000 per month and Rs.3.0 lakh contingency per annum.
Web: www.csirhrdg.res.in

Jawaharlal Nehru Memorial fellowship (JNMF)
The fellowships are open to scholars in every discipline - the sciences as well as the humanities. The fellowships are open to the fellows have complete freedom to work at places of their choice with in India.
Stipend: The fellowship is tenable for two years and carries a monthly stipend of Rs.10000/-.
Web: http://www.jnmf.in/fabout.html

National Photonics Fellowship (NPF)
Applications are expected to be final year students in an M.Sc (Physical Sciences) / M.Tech / B.Tech program in a recognized university in India.
Stipend: Rs.12000 per month + HRA as applicable. **Web:** http://www.photonicsindia.org/

DAE - Dr. K. S. Krishnan Research Associateship (KSKRA)
Minimum Educational Qualification and Experience for KSKRA - For Scientists: Ph.D. degree in Science.
Stipend: Rs.26000 per month + Benefits. **Web:** http://www.barc.ernet.in/

UGC - Rajiv Gandhi National Fellowship (RGNF) for SC/ST candidates
This scheme is open to candidates who belong to SC/ST and wish to pursue higher studies such as regular and full time M.Phil and Ph.D degrees in Sciences, Humanities, Engineering and Technology.
Stipend: Rs.12000 p.m. for initial 2 years. Rs.14000 p.m. for remaining tenure. **Web:** http://www.ugc.ac.in/

UGC – Dr. S. Kothari Post Doctoral Fellowship
Candidates who have either received a Ph.D degree or submitted their Ph.D thesis are eligible to apply. The maximum duration of the PDF award would be 3 years.
Stipend: Rs.18000 p.m. to 22000 p.m. with annual increase of Rs.1000 **Web:** http://www.ugc.ac.in/

DST - Ramanujan Fellowships
The applicant should possess a high degree or equivalent such as Ph.D in science/engineering, ME/M.Tech etc. and have adequate professional experience.
Stipend: Rs.75000 per month and Rs.5.00 lakh contingency per annum.
Web: http://www.dst.gov.in/scientific-programme/nsti/ramanujan fellowship.pdf

DST – JC Bose National Fellowships
The applicant should possess a high degree or equivalent such as Ph.D in science/engineering, ME/M.Tech etc., and must have carried out several years of work in the specific area.
Stipend: Rs.20000 per month in addition to regular income.
Web: http://www.dst.gov.in/scientific-programme/nsti/jc bose fellowship.pdf

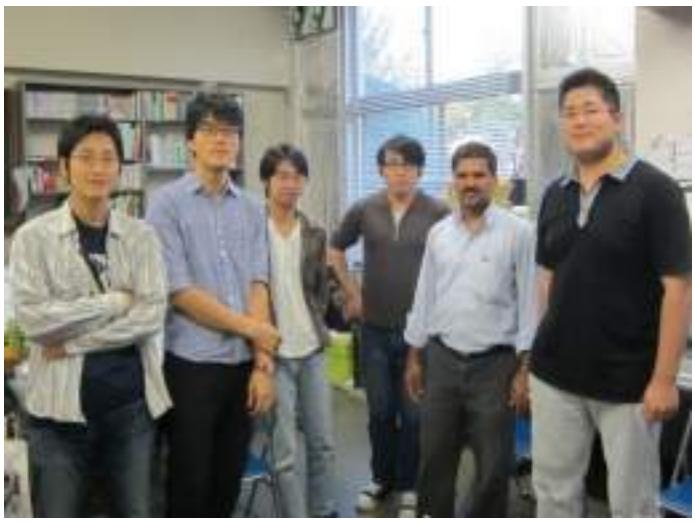
SERC – Swarnajayanti Fellowships
The applicant should possess Ph.D in science/engineering. Scientist should be active in the frontier area of science and engineering with outstanding contributions in his/her area of research.
Stipend: Rs.25000 per month in addition to regular income. **Web:** http://www.serc-dst.org/swarnjayanti.htm

INTERNATIONAL CONFERENCE/LABORATORY VISIT

Dr.N.Vijayan attended the Training course on X-ray fluorescence organized by Rigaku Corporation, Japan during 9-21 Januray 2012

Silicon Crystal Growth Group, GT Solar Corporation Ltd, Shanghai, China with **Dr.N.Balamurugan**

Dr.J.Ramajothi, Prist University with Prof. Shizuyasu Ochiai, Aichi Institute of Technology, Toyota, Japan



Dr.R.Ramesh Babu, Bharathidasan University with Prof.Othiai group at Aichi institute of Technology,Toyoto, Japan

Dr.P.Rajesh with Prof.T.Kuech, Principal Editor, Journal of Crystal Growth in The 16th International Conference on Crystal Growth (ICCG-16) at China, 18-13, August 2010

Dr.T.Prem Kumar with Prof.Jae Hyung Jang, CIGS Solar Cell Group, Gwangju Institute of Science and Technology, Republic of Korea

SOME OF THE CRYSTAL GROWTH RESEARCH GROUPS

Crystal Growth and Materials Research Group, University of Jammu with **Dr.R.P.Pany**, Scientist G, NPL, New Delhi

Dr.S.S.R.Inbanathan and his Research Students in PG & Department of Physics, The American College, Madurai

Dr.R.Ramesh Babu and his Ph.D Students in Crystal Growth and Thin Film Lab, Bharathidasan University, Trichy

Dr.A.T.Ravichandran and his Research Students in Department of Physics, National College, Trichy

Dr.J.Thomas Joseph Prakash (PG & Research Department of Physics, H.H. The Rajah's College, Puthukkottai) and his Ph.D students with **Prof.P.Ramasamy, President-IACG**

Dr.K.Sethuraman and his Research Students in Crystal Growth and Thin Film Lab, School of Physics, Madurai Kamaraj University (MKU), Madurai

PAST CONFERENCES/SEMINARS/WORKSHOPS

Prof.P.Ramasamy delivering the welcome address in XVI National Seminar on Crystal Growth, Aditanar College of Arts and Science, Tiruchendur, 19-21 January 2012

Inauguration of Workshop on Preparation, Characterization of Crystalline Materials and their Applications, Department of Physics, Anna University, Chennai, 16-17 July 2012

The release of the proceedings in National Seminar on New Materials Research and Nanotechnology, Government Arts College, Ooty during 12-14 September 2012

Inauguration of DRDO Sponsored Second National Conference on Recent Trends in Materials Science, KSR College of Technology, 12-13th October 2012

Inauguration of II National Conference on Advanced Materials held at PSN College of Engineering and Technology, Tirunelveli during August 25-27, 2010

Inauguration of XIV National Seminar on Crystal Growth held at School of Advanced Sciences, VIT University, Vellore during March 10-12, 2010

The release of Conference Proceedings in National Conference on Advanced Materials, PSN College of Engineering, Tirunelveli, 25-27 August 2010

UGC Sponsered National Seminar on Recent Trends in crystal Growth and Nano Materials, National College, 15-17 March 2012

The release of Conference Proceedings in National Conference on Advanced Research Concepts in Physics, Department of Physics, Rajahmundry, 24-25 November 2011

Prof.M.J.Joshi and **Dr.K.K.Bamzi** in National Symposium on growth of detector grade single crystals, BARC, Mumbai, 19-21, November 2009

Department of Physics, Anna University, Chennai Organised a "Two Day Tamil Conference on Crystal Growth", 18-19, October 2010

The release of Proceedings in the "Two Day Tamil Conference on Crystal Growth", 18-19, October 2010

INDIAN ASSOCIATION
FOR CRYSTAL GROWTH
Centre for Crystal Growth, SSN College of Engineering, Chennai 603 110

IACG "PROF.P.RAMASAMY NATIONAL AWARD FOR CRYSTAL GROWTH"

Norms for the Award

1. Any Indian Scientist who has contributed to the field of crystal growth is eligible for the award.
2. Any foreign scientist who has contributed to the development of crystal growth activities in India is eligible for the award.
3. Individual or Institution/Laboratory can be considered for the award.
4. Preference will be given to the crystal growth research carried out in India.
5. The research works carried out in the preceding five years of the year of award to be considered primarily for the award.
6. There is no age limit.
7. Self nomination/Nomination by the member of IACG/Nomination by an Institution can be accepted.
8. Scientist/Institution awarded once will be eligible for this award again only after five years from the date of previous award.
9. Award will be given once in two years, initially. Any more donation from any donor under same title is to be additive to the sum already donated and the award can be given annually.
10. The President, IACG may take the advice of the committee constituted by him for the purpose of selecting suitable awardee (s) and the decision of the President will be final.

HONORS/AWARDS

The President IACG, handing over the Memento to **Prof.R.Dhanasekaran** in UGC Sponsored National Seminar on Recent Trends in crystal Growth and Nano Materials held at National College, 15-17 March 2012

The Chairman, Sri Vidya Mandir Arts and Science College, Krishnagiri handing over the Memento to **Dr.K.Srinivasan** in One day seminar on Crystal Growth: Fundamental to Tech. on 13th September 2012

The Principal, GASC handing over the Memento to **Prof.P.Ramasamy** in National Conference on Advanced Research Concepts in Physics, Department of Physics, Rajahmundry, 24-25 November 2011

The President IACG, handing over the Memento to **Dr.D.Arivuoli** in UGC Sponsored National Seminar on Recent Trends in Crystal Growth and Nano Materials held at National College, 15-17 March 2012

Research students felicitating and handing over the memento to **Prof.K.Ramamurthi**, Bharathidasan University, Trichy on his farewell function

The Chairman, PSNCET handing over the Memento to **Prof.P.Ramasamy**, President-IACG in XV National Seminar on Crystal Growth at PSNCET, Tirunelveli (23-25 February 2011)

XIV National Seminar on Crystal Growth held at School of Advanced Sciences, VIT University, Vellore during March 10-12, 2010

XVI National Seminar on Crystal Growth held at Aditanar College of Arts and Science, Tiruchendhur during January 19-21, 2012

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