

Photonics News ONLINE

Bulletin of International School of Photonics
Cochin University of Science & Technology

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Volume-05, February 2003

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ISP website bags Golden Web Award

The website of International School of Photonics, Cochin University of Science & Technology, (<http://www.photonics.cusat.edu>) has won the Golden Web Award for the year 2003- 2004. The site which was launched in early 2002 contains information on the all round activities of the School as well as on the frontier areas of Photonics related research and development.

International Association of Webmasters and Designers (<http://www.iawmd.com/>) to those sites whose web design shows originality and contents have achieved a level of excellence deserving recognition. Founded in 1997 with international support, Golden Web Award that also carries a certificate of merit is a free service of the Association.



Home page of International School of Photonics

A website submitted for review to IAWMD is sent to the members whose opinions decide whether a

PDF version (coming soon)



from powerful modern lasers can safely remove material from a tooth without damaging the surrounding area. Previous attempts to develop this technique have failed because they used longer-lasting laser pulses that heated and cracked healthy parts of the tooth.

(A. Rode et. al., J. Appl. Phys., 92, 2153, 2002)

Hollow core photonic crystal fibre raman laser

Laser physicists in the UK have reduced the threshold power needed for stimulated Raman scattering by two orders of magnitude. The Bath University team says that the breakthrough - which exploits a low-loss, hollow-core photonic-crystal fibre filled with hydrogen - marks the beginning of a new era in gas-based nonlinear optics.

(F Benabid et al., 2002 Science, 298, 399)

Electrical pulses break light speed record

Pulses that travel faster than light have been sent over a significant distance for the first time. Alain Hache' and Louis Poirier of the University of Moncton in Canada transmitted the pulses through a 120-metre cable made from a coaxial 'photonic crystal'. To create their cable, the Canadian researchers joined together five-metre sections of coaxial cable with alternating electrical impedance. They sent electromagnetic pulses with frequencies between 5 and 15 MHz through the cable, and found that the group velocity reached 3 times the speed of light for frequencies in the absorption band. This was remarkable in comparison with many existing information systems that are based on coaxial cables with data speed of just two-thirds the speed of light. The achievement that utilized the back-reflection caused by impedance mismatch raise hopes that data could travel through electronic communications systems at almost the speed of light.

(A Hache' and L Poirier 2002 Appl. Phys. Lett. 80 518)

A breakthrough in teleportation

When physicists teleported photons for the first time in 1997, they had to destroy the photons to be sure that the teleportation had been successful. Now a team at the University of

site ultimately wins the award. The ISP website that has been awarded the Golden Web in the academic institutions category went on air in 2002 as part of the School's objective of reaching a worldwide audience with academic and research programs. Aimed at drawing the attention of the international scientific community to the activities of the department, the knowledge portal provided in the site is perhaps one of the largest online information sites.

The site will sport the logo of the Golden Web Award in future which is a recognition accorded to a winning site by IAWMD. The award has provided a great boost to the site builder Mr. B. Aneeshkumar, whose latest inclusions to the site are a home page dedicated to the Centre for Excellence in Lasers and Optoelectronic Sciences (CELOS) and a common mailing list comprising the faculty, students and administrative staff of the School.

Indo-Dutch Workshop on Current Trends in Photonic Materials & Devices - A Review ISP and International Collaboration

The Indo - Dutch workshop held during January 14-15, 2003 at ISP gave an in-depth view of the present scenario of the Photonic materials and devices that are being used worldwide in industrial as well as research fields.

As part of its academic collaboration with the Eindhoven Technical University in Holland under the Dutch Government's Program of International Co-operation in Higher Education (MHO), the International School of Photonics (ISP) has conducted many conferences and workshops in frontier areas of Photonics related research over the past few years. In the New Year, the international activities of the department were heralded by the 'Indo-Dutch Workshop on Current Trends in Photonic Materials and Devices' held in mid-January at the ISP building.



Prof. V. M. Nandakumaran speaks during the inauguration of the Indo-Dutch workshop

This was also the first academic activity to be organized by the School in its own building in the University campus. Attended by over 40 delegates from across the country, the conference provided an arena for young researchers to present posters and hold discussions with experts drawn from various research laboratories within India and from the Technical University of Eindhoven, The Netherlands.

Vienna has managed to teleport photons without destroying them. Jian-Wei Pan and colleagues believe that their method could be the next step towards long-distance quantum communication. In a standard teleportation experiment, a laser is directed at a crystal with nonlinear optical properties. Occasionally the photon will be "down-converted" into two lower energy photons, and sometimes these photons will have their polarizations entangled wherein one of them is vertically and the other horizontally polarized. By using a filter to reduce the intensity of the photons that are going to be teleported, the researchers were able to significantly reduce the number of spurious detection events. The Vienna team could be 97% certain that the state had been teleported to a photon without actually having to detect it. Such a high accuracy means that the teleported photons could be used in "quantum repeaters" for long distance communication. The team now hopes to combine these results with a technique known as "entanglement purification" to further develop quantum communication over long distances. (*J. -W. Pan et. al. ,Nature, 421 721, 2003*).

Laser takes up gene therapy

Scientists in Germany have used a Ti:sapphire laser to transfer DNA into a cell. Femtosecond lasers improve the transfer of DNA into cells and could advance the fields of gene therapy and DNA vaccination, according to Uday Tirlapur and Karsten König of Friedrich Schiller University in Jena. (*U. Tirlapur and K. König, Nature, 418 290*)

Power from terahertz beams

Terahertz beams are required in many scientific and technological applications, ranging from the imaging of biological materials to manipulating quantum states in semiconductors. However, existing terahertz sources have only been able to generate low-power beams. Now, Gwyn Williams and colleagues at the Brookhaven and Lawrence Berkeley National Laboratories in the US have created a beam that is several orders of magnitude more powerful than any other existing source. (*GL Carr et al., 2002 Nature, 420 153*)



Crystals for Nonlinear Optics

The significance and relevance of nonlinear optics (NLO) as an integral part of photonics is evident from the fact that nearly all the photonic devices make use of various NLO materials in one-way or the other. In the current research, we focus on developing a variety of organic, inorganic and semi-organic bulk single crystals.

From the Editor's Desk

Yet another volume of the Photonics News is in your hands. It is with great pride and pleasure that we bring out the 2003 edition of this newsletter.

The third year of the twenty-first century has been a fruitful year for ISP. Within a short period of eight months the ISP website www.photonics.cusat.edu has won the Golden Web Award for the year 2003- 2004. The award instituted by the International Society of Web Masters and Web Designers will be a boost to ISP and the site has become 'the site that one cannot afford to be left unvisited'. Some of the institutes advise their students to browse ISP website as the first step to take up research in the field of Photonics. The full credit of this remarkable achievement goes to Mr. B. Aneeshkumar who is doing his research work here and jointly at the Technical University of Eindhoven, The Netherlands, under the ISP-MHO programme of the Indo- Dutch collaboration of CUSAT.

Work in the field of Lasers and Optoelectronics at CUSAT has been recognized by the UGC by selecting it as a Potential Centre of Excellence in the field of Lasers and Optoelectronics Sciences. This ambitious five-year scheme is undertaken jointly by the Departments of Physics, Electronics and ISP through a newly established 'Centre of Excellence in the field of Lasers and Optoelectronics Sciences' (CELOS), under the directorship of Prof. C.P. Girjavallabhan. One of the important programmes under this scheme is the starting of a five year integrated M.Sc course in Photonics. Students after their +2 level education are admitted to this course. The first batch of students has already been admitted. We take this opportunity to welcome these young members of the Photonics Family.

Yet another feather in the cap of CUSAT is that we are going to host the Seventh International Conference "Photonics -2004 ", in which about six hundred delegates are expected to take part during December 8-11, 2004. ISP itself has sailed past a landmark by occupying its own building, beautifully designed which as one of the colleagues remarked, as 'owners' pride and neighbours envy'.

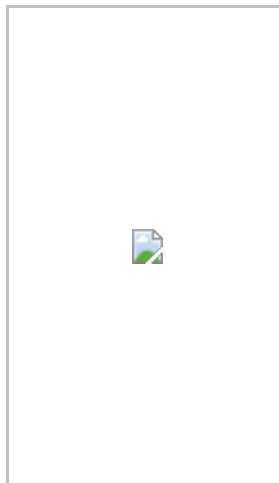
We recollect that Time has black-bordered one of its section by the astronaut Dr. Kalpana Chawla along with six of her colleagues getting dissolved into infinity. Let us remember them as a courageous few who left the earth to fathom the unfathomed cosmos.

V. P. N. Nampoori

Raman's bust installed in ISP

A new chapter was added to the history of International School of Photonics on 9th September 2002 by the unveiling of the bust of Sir C. V. Raman, the Father figure of Photonics in India, in the new ISP building. The Honourable Vice Chancellor of CUSAT,

Prof. N. Unnikrishnan Nair formally unveiled the bust in an official function that was held in the



Two different crystal growth systems, viz., high temperature solution growth (flux growth) and room temperature solution growth have been designed and fabricated for this purpose. Preliminary attempts are being made to develop good quality inorganic single crystals of strontium tetraborate and bismuth triborate by the flux growth technique. Semi organic crystals grown from aqueous solution, such as the

recently discovered L-arginine tetrafluoroborate, L-histidine tetrafluoroborate, etc., with improved nonlinearity, SHG efficiency and mechanical stability are also subjects of our investigation.

Nonlinear Optics with Nanoparticles

Recently we have investigated nonlinear absorption in a silver nanosol and observed that they exhibit induced as well as saturable absorption at the same wavelength, near plasmon band, entirely depending on the excitation fluence. Such a behavior is absent in organic systems. Now we are planning to extend the investigation to composite structures of nanoparticles. organic materials. Such materials, usually called hybrid materials, have potential applications in the design and fabrication of nanodevices, which can revolutionize photonic technology..

Photothermal Studies

Currently we have focused our work on the investigation of nanometal dispersed porous ceramics. The open cell photo acoustic technique has been employed for the evaluation of thermal diffusivity of liquid crystals. The photothermal deflection studies on compound semiconductors has been done by varying the degree of dopants. Investigations carried out on layered structures revealed very interesting properties in the propagation of phonons during their transit through the specimen.

We have been continuing the thermal lens studies of fluorescent materials and recently investigated the effect of silver sol on the Fluorescence Quantum Yield (FQY) of certain xanthene dyes. It has been observed that the presence of silver sol decreases the FQY. This is expected to have an important consequence in enhancing Raman scattering signals, which are often obscured by fluorescence.

Laser Generated Colliding Plasma

Study of laser produced plasma is an important programme of ISP. Recently plasma group has fabricated a multipurpose plasma chamber to investigate colliding plasma under laser irradiation. Studies on dusty plasma and plasma instabilities are also being undertaken.

central hall of the building. The Registrar Dr. K.V. Kunhikrishnan and Prof. K.G. Nair, Director, Sophisticated Testing and Instrumentation Centre (STIC), offered felicitations. The installation of the statue was symbolic of the establishment of the science of Photonics as an integral part of the academic culture of the University.



Near the newly unveiled bust of Sir. C. V. Raman: (From L to R) Prof. C. P. Girjavallabhan, Prof. V. P. N. Nampoori, Prof. N. Unnikrishnannair (V. C.-CUSAT), Prof. K.G.Nair, Dr. K. V. Kunhikrishnan (Registrar), Prof. V. M. Nandakumaran, Mr. Sebastian Ouseph (F. O) and Prof. P. Radhakrishnan

The bust, which now adorns the atrium of the School, is a facsimile of Prof. Raman, capturing the minutest details of his countenance and appearance. The sculptor, Mr. Sasi whose painstaking labour has created a statue that enthalls all who visit the School, will always be mentioned with appreciation and admiration in the annals of ISP history.

CELOS- Recognition where it is due

In view of the outstanding work carried out by teachers and researchers in laser related subjects at CUSAT, the University Grants Commission, India identified Cochin University of Science and Technology as a **"University with Potential for Excellence in Lasers and Optoelectronic Sciences"** in March 2002. This unique scheme is intended to create centres of international excellence in selected areas in a few Universities in India so that these rise as a "National Facility" where scientists and researchers from other teaching/research institutions of the country can make visits to conduct research in the relevant field. Cochin University of Science and Technology will receive a substantial financial assistance to the tune of Rs. 30 crores for a period of 5 years as per this programme. This has led to the establishment of a separate and independent **"Centre of Excellence in Lasers & Optoelectronic Sciences"** (CELOS) in July 2002 with Prof. C. P. Girjavallabhan as its Director and with ISP and the Departments of Electronics and Physics as the participating departments.

As part of its human resource development in the field of Photonics, CELOS has started an Integrated M.Sc Course in Photonics during the current academic year. This programme is intended for students who seek an understanding of the current approaches and emerging directions in Photonics. In the near future the



Plasma chamber fabricated by the group to study collision plasma

Fibre Optics Technology

1. Long Period Fibre Grating:

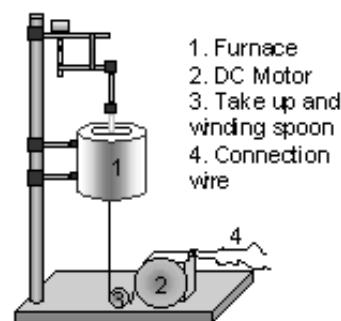
Recent research work in the area of fibre optic technology is centered on the fabrication of long period fibre gratings and employing them for different sensor applications. The gratings have been fabricated in conventional telecommunication fibres, photosensitive fibres and plastic clad silica fibres by the point-by-point method using the third harmonic radiation (355 nm) from an Nd:YAG laser. Characterization of these long period gratings was carried out using an optical spectrum analyzer. These gratings were employed for chemical sensing with large dynamic range. Sensors developed using gratings were shown to detect the presence of iron, nitrite etc. contained in water up to the ppb level.

2. Interferometric Sensors:

Another landmark in sensor research was the development of interferometric sensor to measure force. A very compact and inexpensive sensor was designed and developed for the simultaneous measurement of nitrites and chromium dissolved in water. A notable addition is the development of a sensor for ammonia detection using an indicator dye deposited on an uncladded fibre acting as the sensing element.

3. Polymer Based Fibre Optics

The global proliferation of optical fibre-based communication networks has been the enabling factor in the shift from the Electronics Age to the Information (i.e. Photonics) age.



Schematic of the fibre drawing unit designed in the laboratory

Though earlier silica glass fibres were extensively used, plastic optical fibres (POFs) are of great commercial interest now because they can maintain flexibility at thicker fibre sizes making them easier to handle and install in communication systems. Research group of the fibre lab in ISP designed and developed a

centre will also admit students to the Ph.D programme in Photonics and related fields.

Conference News

Photonics: An Introduction-A Workshop for B.Tech. students

International School of Photonics organized a three-day Workshop for B. Tech. students during 14-16 February 2003. The Workshop was aimed at introducing the fast developing field of Photonics to the engineering students. Experts in the field gave tutorials on the fundamentals of the subject as well as introductory lectures on Photonics related research and development. The lab demonstrations conducted as a part of the Workshop exposed the young engineers to the various realms of the ongoing research in this field.

Annual Photonics Workshop (APW 2003)

Celebrating the occasion of the National Science Day as well as the anniversary of its own inception, International School of Photonics is organizing the Annual Workshop on Photonics this year also during 27-28 February 2003. The primary objective of APW-2003 is to offer an introduction to the various aspects of light-matter interactions. The target group will be young researchers and teachers planning to enter this novel and fascinating field of research. For more details regarding the workshop contact:

Prof. P. Radhakrishnan, Mr. C.M. Basheer, Coordinators, APW 03, International School of Photonics, Cochin University of Science & Technology, Cochin 682022.

Email: radhak@cusat.ac.in

PHOTONIANS - The Alumni Association of ISP

International School of Photonics has been instrumental in bringing out around a hundred postgraduates (M.Tech -OE<) and twenty Ph.D. holders in the area of Photonics within a short period of eight years. It was deemed important that an academic centre of this stature launch its own Alumni Association with the primary objective to keep connected all those who have been part of the Photonics family at CUSAT. The aim of the Association is to enhance interaction between ISP and the former students who are now in various frontier areas of Photonics research and development in both academic and industrial levels. The Association is expected to play a great role in the development of the group in the years to come joining hands with CELOS.

Prof. V.P.N. Nampoori put forward the idea of an Alumni Association. The Alumni Association 'Photonians' was formally inaugurated at a meeting held on 13th January 2003 at ISP by Prof. C. P. Girjavallabhan, Director, CELOS and Founder Director, ISP. The meeting attended by the staff, students and most importantly, many former students of ISP, elected the office bearers of the association. They include:

- The Patron - Prof. V. M. Nandakumaran, Director, ISP

drawing system to fabricate polymer optical fibres using Polystyrene (PS) and Polymethylmetacrylate (PMMA). This group is concentrating on the fabrication of some optical components like couplers apart from dye-doped fibres

Laser Chaos

The work currently being pursued analyses the applicability of long wavelength semiconductor lasers for optical communication especially in the secure communication using chaotic optical systems. Chaotic outputs of direct current modulated semiconductor lasers are used for encoding the message by direct amplitude modulation at the output of the transmitter.

The encoding was done successfully in analog and digital messages. The encryption technique involves the achievement of perfect synchronization between the transmitting and receiving systems as well as a proper masking of the signal in the intermediate stages. A proportional - integral feedback function is successfully used for this purpose and the results are very encouraging. The level of security offered by this scheme and the effect of a time delay in the synchronization of the receiver with the transmitter is being investigated.

Computational Neuro science

The momentum gained in the research of fiber The study of the coordination of the brain regions in normal and epileptic subjects brought forth some interesting results that are expected to be of use to clinicians as well. The establishment of synchronous activity in regions that are far apart during the transient period of an epileptic attack was detected by this method. The complexity of the signals under various conditions involving rest and physical fatigue as well as cognitive and mental task conditions was also carried out. The investigation showed that there exists a difference in the complexity of the EEG signals for women as compared to men. Efforts are also on to devise EEG based brain maps as well as develop these into an online tool for use in diagnosis and treatment of neurological disorders. In addition, the group could establish research collaborations with the Amrita Institute of Medical Sciences, Cochin and the Department of Human Biology, University of Cape Town, South Africa.

In the limelight

- **Mrs. Achamma Kurian** was awarded Ph.D. under the Faculty of Technology, CUSAT, for her thesis entitled "Characterization of Photonic Materials using Thermal Lens Technique." She is currently a Senior Lecturer at the Catholicate College, Pathanamthitta.
- International School of Photonics is to host **PHOTONICS 2004**, a biennially held International Conference on Optoelectronics, Fibre optics and Photonics. The conference is sponsored by SPIE, The International Society for Optical Engineering. The conference is a forum for interaction and exchange of ideas among

- The President- Mr. Jibukumar
- The Vice President- Dr. Achamma Kurian
- Secretary & Treasurer-Prof. P.Radhakrishnan
- Joint Secretaries- Dr. Riju C. Issac (outside India) & Mr. Fazluddeen (within India)
- Staff Advisor- Prof. V. P. N Nampoori
- Executive members- Ms. Bindu Krishnan, Mr. Deepak M. K., Mr. Jameskutty Thomas, Ms. Priyamvada M.C, Mr. Yedukondalu. K and Mr. Satheesh.

The Association has launched a web site, <http://www.photonics.cusat.edu/alumni.html> and an electronic newsletter, which is maintained by Mr. B. Aneeshkumar. These are expected to act as communication links among the 'Photonians'. An editorial board has also been formed for this newsletter "VIBGYOR", which includes Prof. V P N Nampoori, Dr. Reji Philip, Dr. Deepthy A, Ms. Rekha Mathew, Mr. Manu Punnen John and Mr. Jijo P.U. The Association is well into action by organizing a seminar jointly with the Photonics Society of India by Prof. V P N Nampoori in honour of Late Dr. Kalpana Chawla on 13th of February 2003.

Alumni Column

Carbon Nanotubes - Material of the decade Sudhir C, Laboratoire POMA, Université d'Angers, France

Email: sudhiram@yahoo.com

It is there in everything living and dead. It can be in what you drink and what you wear. It can be soft, it can be hard! It can be ugly and the most beautiful! It is Carbon. It is a special element that has fascinated chemists. Carbon can take various forms like soft and slippery graphite to the hardest natural substance ever discovered, diamond. Carbon can be in the form of a football, fullerene, or it can be in the form of tubes, nanotubes! Meet the latest (although fullerene structures were discovered after) incarnation of carbon, Nanotubes ! Sumio Iijima and coworkers at the NEC labs reported the discovery of carbon nanotubes, in 1991, while the first carbon filaments of nanometer dimensions were prepared by Morinobu Endo in France.

Carbon nanotubes are hexagonal networks of carbon atoms that is rolled up in the form of a seamless cylinder. These structures have exceptional electronic and mechanical properties. High-resolution transmission electron microscope (TEM) and scanning electron microscope (SEM) photographs of carbon nanotubes have confirmed that carbon nanotubes are cylindrical structures with hexagonal lattice. Three possible structures namely armchair, zigzag and chiral are differentiated depending upon the rolling of graphene layer. A vector called Chiral vector determines the type of the nanotube. In a two dimensional hexagonal lattice, a chiral vector may be defined as $C_k = na_1 + ma_2$ where a_1 and a_2 are unit vectors in the two dimensional hexagonal lattice. The angle between the chiral vector and a_1

participants from research institutions, universities, government organizations and industry. For more information visit the [conference home page](#)

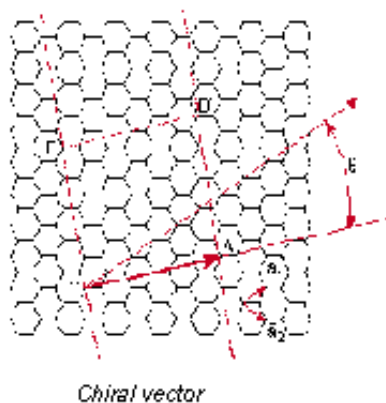
Seminar by Visitors

1. **Prof. R. Pratap**
Prof. Emeritus, ISP
Evolution of Thought Function
8th February, 2002.
2. **Dr. V. Kumar**
Scientist, Centre for Materials for Electronic Technology, Thrissur.
Synthesis of Nanocrystalline Materials
15th April 2002
3. **Dr. G. D. Sockalingam**
University of Reims, France
Biomedical Applications of Vibrational Spectroscopy.
12th November 2002
4. **Dr. C. Murali Krishna**
Centre for Laser Spectroscopy, MAHE, Manipal
Laser Spectroscopy for diagnosis and early detection of malignancy
12th November 2002
5. **Prof. Dino Jaroszynski**
University of Strathclyde
Intense Laser Interaction with Plasma
13th December 2002.

Accolade

1. **Prof. V P N Nampoori** attended the Belgium Photonics Fabrication Europe Conference held during 28th October-1st November 2002 at Brugge. He presented papers on fibre optic sensors by Thomas Lee S and P Suresh Kumar at the Transducing Materials and Devices conference.
2. **Dr. A. Deepthy**, DST Young Scientist Fellow at ISP, won the best thesis award at the National Laser Symposium 2002, held at Thiruvananthapuram. Her thesis entitled "Growth and Physical Properties of Nonlinear Optical KTP and Ferroelectric GPI single crystals" was done under the supervision of Prof. H.L. Bhat at the Indian Institute of Science, Bangalore.
3. Research Scholars of ISP, **Thomas Lee S** and **Sajan D. George** presented papers at the Photonics Asia-02 along with **P. Suresh Kumar** and **K. Geetha** at the APOC-2002 held at Shanghai, China in October 2002.

is often termed as the chiral angle.



As the graphene sheets (single sheets of graphite) are rolled into tubes or cylinders, these chiral vectors meet. Thus chiral vectors form circumferences of the nanotubes in the cylindrical cross section. The values of the integers n and m determine the type of the nanotube. An $n = m$ value is that of the armchair type, while if either of n or m equals zero with the chiral angle 0, it is zigzag. All other types are classified under chiral nanotubes. The properties of the nanotubes are determined by their diameter and the chiral angle.

Nanotubes of carbon are prepared by laser vaporization of a carbon target in a furnace at 1200°C. Cobalt, nickel or iron catalyst prevents the ends from being "capped" during synthesis, thus allowing the tubes to grow. Pyrolysis and microwave plasma CVD are also common. The detailed mechanism of the growth of nanotubes is yet to be completely understood.

Carbon nanotubes have unique electronic and mechanical properties. The electrons in the nanotubes are well quantum confined, normal to the tube axis (the idea of quantum wires!). Thus they can propagate along the nanotube axis and their wave vector will be in the axial direction. Carbon nanotubes can be in the form of semi conductors or metals depending upon the direction in which the nanotubes are rolled. This is because the electronic structure of graphene is dependent on the boundary conditions. The metallic nature depends on their diameter and chirality. The singularities that correspond to the sub bands differentiate them from conventional metals. Another interesting property of steel carbon nanotubes is the exceptionally high mechanical strength with a Young's modulus of 1 TPa (10^{12} N/m²). This is as much as five times that of steel! Unlike carbon fibers, they form kink like ridges that can reform under the release of the stress.

Interludes

Musical interlude by Ramesh Babu and S. P. Radhakrishnan, C. P. G. Vallabhan, V. P. N. Nampoori, 2003



Thangal lights



Happy times at Vallabhan



The galaxy in the space square

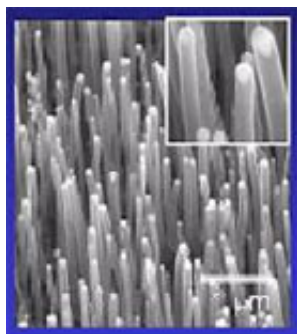


One, I believe in progress

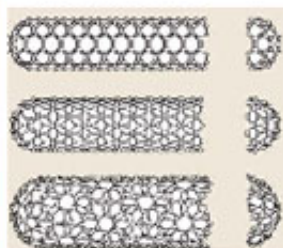
Click to Enlarge

Recent publications from ISP

1. Thermal lens spectrum of organic dyes using optical parametric oscillator.
Achamma Kurian, K. P. Unnikrishnan, Sajan D. George, Pramod Gopinath, V.P.N Nampoori & C. P. G. Vallabhan. Spectrochimica Acta part A, 59 , 487-491, 2003.
2. Studies on two-photon absorption of aniline using thermal lens effect.
Achamma Kurian, K P Unnikrishnan, S Thomas Lee, Sajan D. George, V P N Nampoori and C P G Vallabhan.
J. of Nonlinear Optical Physics & Materials.
3. Effect of pH on quantum yield of fluorescein using thermal lens technique.
Achamma Kurian, Nibu A George, Sajan D George, K P Unnikrishnan, Binoy Paul, Pramod Gopinath, V P N Nampoori and C P G Vallabhan, Journal of Optics, 31 (1), 29-36, 2002.
4. Studies on fluorescence efficiency and photodegradation of rhodamine 6G doped PMMA using thermal lens technique.
Achamma Kurian, Nibu A George, Binoy Paul, V P N Nampoori and C P G Vallabhan.
Laser Chemistry, 20 (2-4), 99-110, 2002.
5. Realization of optical logic gates using thermal lens technique.
Achamma Kurian, Nibu A George, S. Thomas Lee, K P Unnikrishnan, V P N Nampoori and C P G Vallabhan.
Laser Chemistry, 20 (2-4), 81-87, 2002.
6. Photoacoustic measurement of transport properties in doped GaAs epitaxial layers.
Sajan D George, Dilna. S, P. Radhakrishnan, C. P. G. Vallabhan and V.P.N.Nampoori.
Physica Status Solidi (A), 195 No-2, 416-421, 2003.
7. Effect of Te doping on thermal diffusivity of Bi₂Se₃ crystals: A study using open cell photoacoustic technique.
Sajan. D. George, Saji Augustine, Elizabeth



SEM photograph of vertically grown nanotubes with Nickel catalyst



Different types of nanotubes

These special electronic and mechanical properties of carbon nanotubes make them highly potential and promising candidates for multifarious applications. The excellent mechanical properties can be exploited for reinforcement applications, lightweight bulletproof vests and nanotube tips for scanning probes.

The field emission properties in nanotubes have led to the development of nanoscale electronic transistors. The idea of a nanotube field emitter was first proposed by deHeer et. al. In a recent paper, Ali Javey and colleagues have claimed to have fabricated and studied carbon nanotubes integrated with a gate of high dielectric constant, thus enhancing the performance. Recently, Zhifeng Ren and co workers of Boston College, Massachusetts demonstrated that large area periodic arrays of well-aligned carbon nanotubes could be fabricated on Ni dots using a self-assembly lithographic technology. A 'crystal forest' was created by laying down periodic nanodots of Nickel by depositing the metal in the interstices of a two dimensional colloidal crystal. The defects in the waveguides act as optical waveguides. A vacant row of posts will create a channel permeable to the otherwise forbidden wavelengths. If realized this would pave way to molecular optoelectronics.

Owing to such exceptional features, Carbon nanotubes are the most researched nanostructures. The quantum nature of nanotubes and their electronic structures will be explored in the coming years. We can expect the development of new electronic elements based on carbon nanotubes. But what next? Science will find its way out.

We hear that

Spotting of excited molecules

Marcus Dyba and Stephen Hall of Max Planck Institute Germany spotted excited molecules of 33nm width using the focused light of 760 nm radiation and conventional optics along the optic axis. This was accomplished by exciting the molecules with a femto second pulse and subsequent depletion of their excited state with red shifted pico second pulsed counter propagating coherent radiation. The sub diffracted 1/23 spot enabled for the first time to image the membrane of bacillus megaterium using far field fluorescence microscopy. The technique could be

Mathai, P. Radhakrishnan, V. P. N. Nampoori and C. P. G. Vallabhan.

Physica Status Solidi (A), In press.

8. A photoacoustic study of the effect of doping concentration in the transport properties of GaAs epitaxial layers.

Sajan D George, Dilna. S, Prasanth. R, P. Radhakrishnan, C. P. G. Vallabhan and V. P. N. Nampoori.

Optical Engineering ,42(5), 2003.

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useful in micro lithography and optical data storage.
(PRL 88, 163901, 2002)

Laser leads nerve growth



Researchers have shown that a laser beam can guide nerve cells to grow in a particular direction. This technique must

help damaged nerves to re-grow or could convert them to electronic implants such as artificial retinas and prosthetic limbs. Nerve cells growing over a glass plate take the path pointed out by a red laser, reports Allen Ehrlicher of University Leipzig in Germany. The nerves move towards the spot of laser light traveling as if drawn by a gentle slope. The laser does not harm the cells even if they are forced to take sharp turns.
(Nature, Science update, December 2002.)

Adaptive optics gives a hand to opticians

Donald Miller and Larry Thibos of Indiana University have used a technique normally used in astronomy to see living cells in the human retina for the first time. They believe that instruments that use "adaptive optics" could help in the early diagnosis of retinal diseases. They created an "ocular aberrometer" to measure the deviation in optical wavefronts reflected by the retina and also developed technology that corrects these deviations. Combined with a retina camera, the researchers will be able to make high-resolution, non-invasive observations of cells at the back of the eye.
(Physics Web, January 2003)

Laser-Dentist

Dentists could soon swap their drills for painless tools based on pulsed infrared lasers. Andrei Rode of the Australian National University and his colleagues have shown that ultrashort pulses of radiation



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And the last word...

When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it; this is knowledge
-Confucius

The only thing I know is that I do not know anything
-Socrates

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