February 2017 Volume 19

PHOTONICS NEWS

INTERNATIONAL SCHOOL OF PHOTONICS

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DIRECTOR's MESSAGE

Dr.A.Mujeeb

Laser based Optoelectronic systems have emerged as one of the prominent technologies in the present century with potential applications in diverse fields such as medicine, communication, manufacturing process, sensor technology, etc. The field of Photonics has seen phenomenal growth during the short span of last two decades and the contribution of International School of Photonics in achieving its goal and to this growth is remarkable. The rewarding remark of the NAAC team, one among the three major features in CUSAT, exemplifies the glory of ISP that it excelled at the national level. I am indebted to the co-operation and whole hearted support of all the faculty members, administrative, technical staff, research scholars and students for this achievement.

From this year onwards we are changing the tradition of Annual Photonics Workshop to National Photonics Symposium which is also one among the several diversified activities of the School. I am delighted to note that several invited and contributed papers would be presented during this symposium, reflecting the state of the art Photonics developments and research. I am sure that this symposium is scientifically rewarding and provides a good opportunity for interaction and exchange of ideas between academicians, researchers, scientists, etc. Also I am confident in showcasing our strength and achievements in research activities in this School through this publication. I congratulate the editorial team for their earnest effort in publishing this news and appreciating all the authors for their enrichment.

I extend my best wishes to all the readers.

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"When you know better, you do better"- Through our Technical Articles

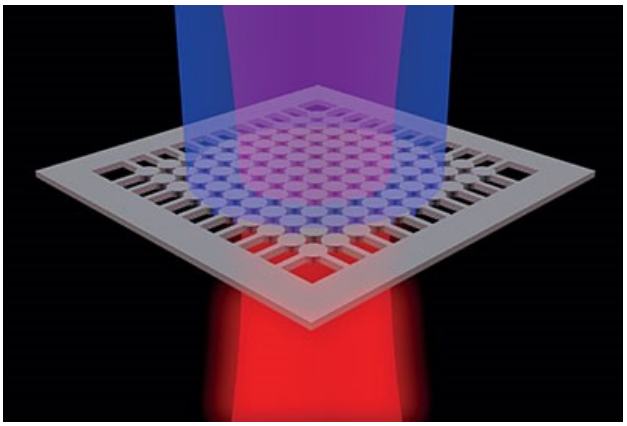
Tiny Efficient Lasers realized with Optical Super Cavities

Optical microcavities and microstructures have been extensively used in the past to investigate lasing characteristics of active media and to fabricate microlasers and optical microsystems. In ISP, CUSAT we have been studying micro ring lasers and mini lasers made using hollow fibers during the past few years. Microcavity lasers usually possess very small size and very large quality (Q) factor and they come in different geometrical shapes like microsphere, microring microcylinder, microdisc etc. Such systems most often exhibit very interesting and sometimes puzzling lasing characteristics. Now at the University of California, San Diego a team of scientists led by Boubacar Kante has come up with a new type of compact and highly efficient lasers using a type of cavity called the 'supercavity'. This new laser system is supposed to have immense applications in telecommunications, optical spectroscopy and in optical trapping and manipulations. These tunable devices can produce output light with a range of different beam profile. The new system uses a wave phenomenon first proposed more than 80 years ago during the period of initial stage of development of quantum mechanics and then forgotten for a long time.

In1929 von Neumann and Eugene Wigner showed that Schrodinger equation gives bound states above the continuum threshold. Such peculiar states are called 'Bound States in Continuum' or BIC for short and these manifest as resonances that do not decay. The idea lay dormant for a long time as BIC was considered only as a mathematical curiosity but in 1977 it was suggested that BIC could be observed in semiconductor superlattices. In the January 12, 2017 issue of Nature Kante and his colleagues that included an Indian, Ashok Kodigala reported lasing action from an optically pumped BIC cavity at room temperature. They also show that BIC's are ideally suited for the design of perfect nanophotonic cavities and devices. It is now understood that BIC's are general properties of all waves and it can occur in classical systems associated with light, sound or microwaves. BIC's harness optical modes residing in radiation continuum and at the same time possess arbitrarily high quality factor Q.

The UCSD team fabricated GaAsP multiple quantum well cylindrical structures working as nanoresonator arrays suspended in air. All structures are fabricated using electron beam lithography followed by reactive ion etching to form the cylinders. They used 8x8 arrays with supporting bridges for structural stability. The period of the array was 1200nm with a thickness of 300 nm. The radius of the cylindrical nanostructure is a key factor in the BIC design. When pumped with 1064 nm pulsed radiation the devise showed a threshold pump power of 56 µW and lasing action occurred at 1.55 µm.

The BIC supercavity allows the device to produce efficiently high quality laser light even when the device size is extremely tiny. Also the light is emitted vertically from the surface of the array and this offers convenience during the production process. One of the great advantages of the system is that it works at room temperature. Basically it is a simple semiconductor array and as such the device dimensions can be changed easily. Larger arrays can produce a greater amount of light. Tunability can be achieved by changing the dimensions of the semiconductor cylinders. This is very convenient for the design of instruments for spectroscopy especially in space applications and planetary probes.



One interesting feature of the BIC lasers is that it produces 'vector' beams of light so that the output can have Gaussian distribution or doughnut shaped beams. Such light beams can be used as optical tweezers to trap, manipulate and study tiny particles like bacteria or biological cells. Vector beams can also possess an orbital angular momentum and such beams are called 'twisted light' which can have a number of applications. Increasing the data capacity of optical telecommunication networks is an important application of twisted light.

Prof. C.P. Girijavallabhan

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LASER BEAM ANALYZER

On line monitoring of Laser beam profile and measurement of beam quality has become a technological and industrial requirement. The beam profile, in contrast to the raw power or energy, is the unique pattern of irradiance distribution across the laser beam. High quality or Gaussian beams are much more useful than low quality beams for applications requiring high intensities and small focal spots but not optimum for many other applications, say for example surface treatment. Thus it is essential to monitor the beam profile in any application where the energy distribution affects the performance of the laser and its intended purpose.

The common way to quantify beam quality is by using beam parameter product (BPP) and M2 introduced by A.E.Siegman. Here BPP is the product of beam diameter at the beam waist (w0) and far field beam divergence (θ). M2 is the ratio of BPP of real beam to that of ideal Gaussian beam.

$$M^2 = \left({}^{w_0\theta}/_{w_{00}\theta_0}\right) \geq 1$$

Here, w00 and θ0 represent waist radius and divergence of TEM00 mode. From equation (1), the M2 of an ideal Gaussian beam is equal to 1. The practical value of M2 for any laser beam is greater than 1. The ISO definition for the quality of a laser beam uses M2 as the fundamental quality parameter. The Fig:1 shows two ideal beams, a Gaussian beam profile and a flat top beam profile.

With the advancement in computer technology, measurement and analysis of quality of laser beam becomes easier. Improved numerical algorithms made it possible to do beam propagation calculations and display the results with near-instantaneous response on screen graphs and plots.

There are basically two methods for beam profile measurement. They are moving aperture method and sensor method. Moving-aperture profiling involves moving a slit, knife-edge or a pinhole through the beam and detecting the light passing through the moving aperture. Sensor method now essentially means camera based method. Indeed using a few CCD cameras together with high-quality beam splitters the waist position, waist size and M2 can be calculated from a single laser pulse. The significant advantage of camera-based system is that they profile the entire beam simultaneously and give a picture of the full 2D& 3D pattern. These profilers work with both pulsed and CW lasers and there is a broad range of software features available to fit almost every user's application. Commercially available camera-based profiler consists of a camera to receive the laser beam, a computer and software to display the profile and a wide variety of optics to attenuate the beam before entering the camera.

Once the beam profile is recorded then the challenge is to estimate beam width and divergence. There are several definitions for beam width that have been suggested or used for optical beams in the past. This include Width (or half-width) at first nulls, Variance σx of the intensity profile (second moment method), width at 1/e or l/e2 intensity points, "D86" Diameter containing 86% of the total beam energy, transverse knife edge widths between 10%-90% or 5%-95% integrated intensities, width of a rectangular profile having the same peak intensity and same total power, width of some kind of best fit Gaussian fitted to the measured profile, etc. Among all these methods, the ISO standard and beam propagation theory indicate that the second moment is the most relevant one in beam width measurement since this method follows the beam propagation laws and the predict future beam size accurately. The second intensity moments of an arbitrary field can be identified with the beam size, the angle of divergence and the radius of curvature. If we assume that the origin of the reference frame coincides with the centers of gravity the first moments of the field vanish. At the beam waist the radius of curvature is infinite. By using this definition, the generalized law for free space propagation of an arbitrary field over a distance z has the same form as for Gaussian beam propagation .

$$< w^2 > = < w_0^2 > \left[1 + \frac{z^2}{< z_0^2 >}\right]$$

The product of the waist $\sqrt{< \omega_0^2 >}$ and the divergence $\sqrt{< \theta^2 >}$ is called the $\left[<w_0^2><\theta^2>\right]_{TEM_{00}} = \frac{\lambda^2}{\pi^2}$ beam parameter product.

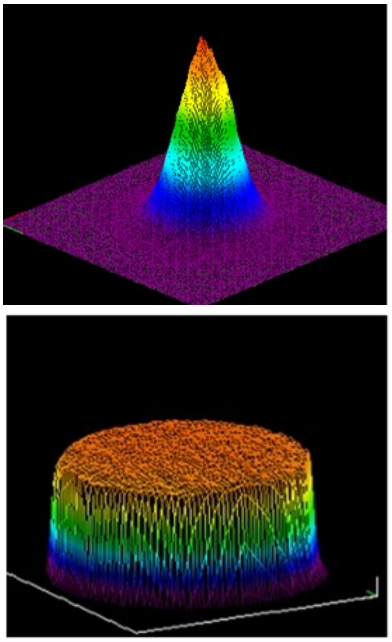


Fig: 1 - Two ideal beams - Gaussian beam profile and flat top beam profile

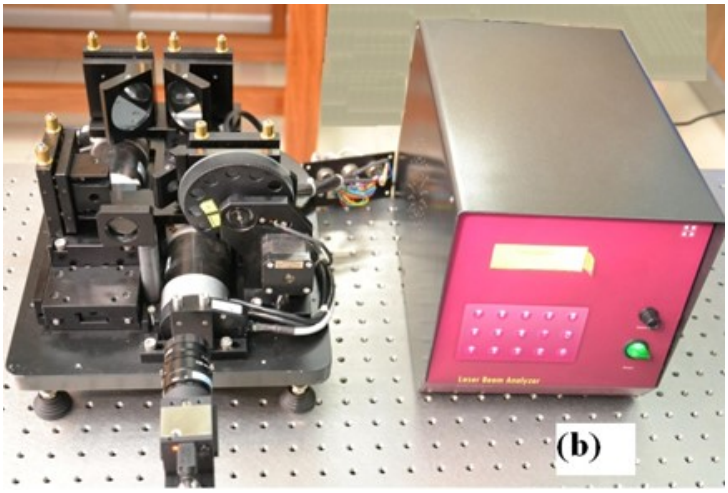
It characterizes the beam quality. In the best-case of a Gaussian beam it results in

For higher order modes with rectangular symmetry one obtains:

$$\left[\langle w_0^2\rangle\langle\theta^2\rangle\right]_{TEM_m} = (2m+1)^2\,\frac{\lambda^2}{\pi^2}$$

And in circular symmetry

$$\left[\langle w_0^2\rangle\langle\theta^2\rangle\right]_{TEM_{pl}} = (2p+\ell+1)^2\,\frac{\lambda^2}{\pi^2}$$



Laser Beam Analyser setup

Here m, n and p, l represent mode label in rectangular and cylindrical co-ordinates respectively. Arbitrary fields, especially high power laser beams, are a mixture of modes and the beam parameter product is defined by:

$$\left[\langle w_0^2\rangle\langle\theta^2\rangle\right]_{general} = M^4\,\frac{\lambda^2}{\pi^2}$$

where M^2 being the beam propagation factor. With the exception of the fundamental mode (Gaussian beam $M^2 = 1$), the beam propagation factor is always larger than one. M^2 is a constant of the beam and does not change during propagation through ABCD-type optical systems.

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Dr. S.K. Sreenivasan Nair

Visiting Professor –ISP

Optical fiber based biomedical imaging: An overview

Optical techniques like microscopy and spectroscopy have become an indispensable tool in the clinical environment. Interfacing optical fibers into the interrogation system provides a flexible solution for studying regions inside tubular structures and cavities which are inaccessible by conventional techniques. This has resulted in employing optical fiber probes for studying biochemical changes and for medical diagnostics. An effective interdisciplinary research involving physics, engineering, biology and medicine will be a strong foundation for studies leading to such technological advances.

There are a variety of reported probe designs for obtaining localized or depth-resolved spectroscopic data. Fig. 2 shows a single-fiber probe configuration for biomedical applications. In this system the light from the excitation source is coupled to the probe employing a single fiber and the fluorescence signal from the sample is collected by the same fiber and is coupled to the detector.

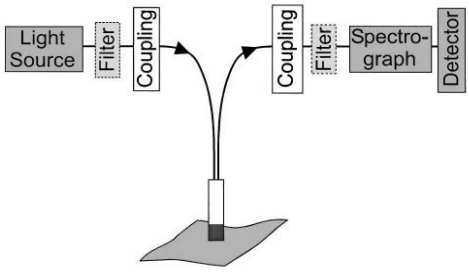


Fig. 1 Multiple fiber probe configuration

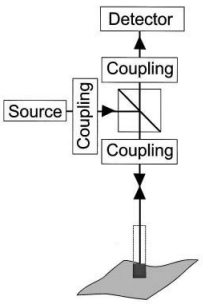


Fig. 2 Single fiber probe configuration

Fig. 1 shows a multiple fiber probe configuration. In this configuration, independent fibers are used as the probe for illuminating the target and as collecting fiber of radiation at the detector side. This minimizes the background signal although at the expense of larger probe size. Angled configurations for illumination and collection fibers that can be used to target specific depth regions are also reported. In most of the common applications, researchers use normal incidence illumination-detection scheme as shown in Fig. 3a. The limitation of this technique is that if subsurface regions have to be studied, the signal from the top layers will cause a decrease in the efficiency of the system. To overcome this limitation, researchers have employed oblique-incidence illumination and collection for increasing the depth sensitive detection.

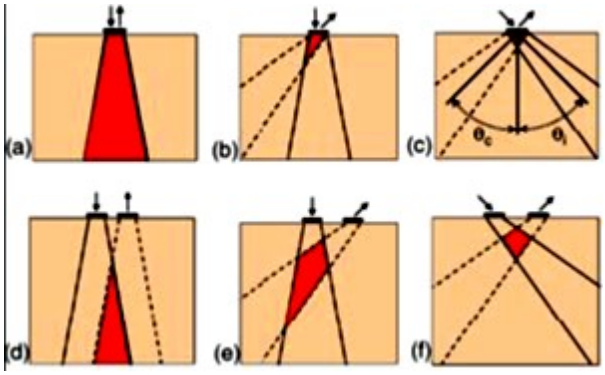


Fig. 3 Different schemes for oblique-incidence illumination and detection

In another study, the effect of probe to target (PTD) distance on the diffuse reflectance is studied (Fig. 4). Studies are done using both common illumination and collection channel using a single fiber and by separate illumination and collection channel using two bifurcated fibers. This study shows that PTD and probe design influence the light collection efficiency and the volume from which light is collected.

The reflected light from the sample is collected through the collection channel. Three different configurations are investigated as shown in fig 4 namely single fibre probe and multiple fibre probes of different configurations. The results achieved reflect that the overlap between illumination and collection channels is an important aspect in probe development.

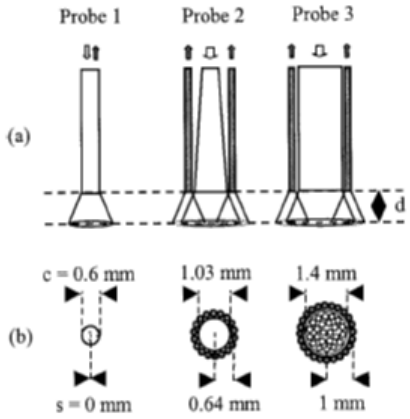


Fig. 4 Different probe configurations

Confocal Microscopy

Discussions described above focused on the probe design aspects for specialized applications. These configurations have limitation in achieving high spatially resolved information in a probe based system. Confocal microscopy technique is a relatively simple design that gives high spatial and axial resolution. A simple approach to integrate this technique into a probe system is shown in Fig. 5. In this setup, an optical fiber is used instead of a pinhole to achieve confocal imaging.

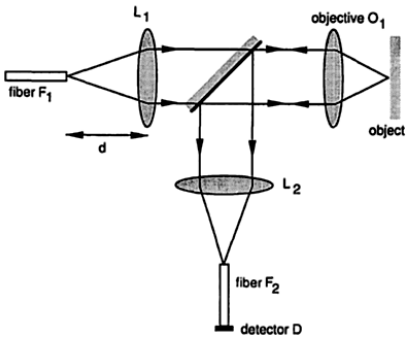


Fig. 5 Fiber based confocal system

The light from the illumination pinhole is collimated by a lens and then focused to the sample with the help of a microscope objective. The fluorescent light originating from the focus is collimated by the objective and is then focused by a lens into the detector fiber which acts as the detection pinhole. The flexibility of the fiber allows in-vivo imaging.

This system can be modified for hyperspectral imaging by employing a tunable source. Fig. 6 shows the integration

of photonic crystal fiber (PCF) into a confocal system for hyperspectral imaging. In this system, the source is a Ti-Sapphire laser pumped through a PCF to generate supercontinuum.

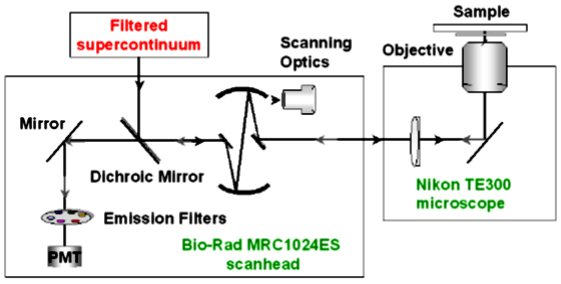


Fig. 6 Hyperspectral confocal imaging

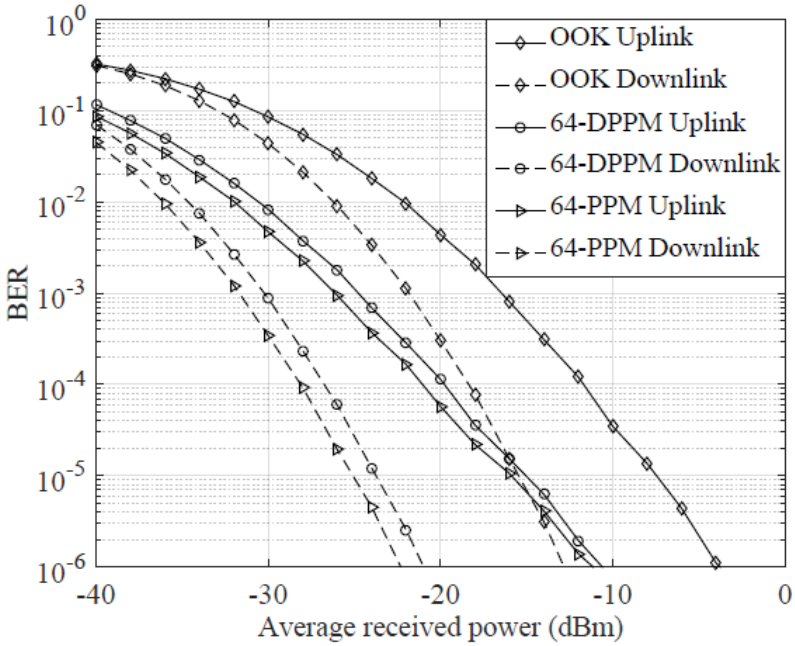
The present trend in bioimaging is to incorporate the conventional imaging techniques into probe based schemes. Optical coherence tomography (OCT) is a technique that has made an impact when dealing with depth resolution. In this setup, light from a xenon arc lamp is spectrally modulated in a Michelson interferometer prior to illuminating a conventional full field optical coherence microscopy (FFOCM) interferometer.

There are other methods for biomedical diagnosis like fluorescence lifetime imaging for better sensitive techniques which can be employed in a minimally invasive manner. The present article provides a flavor of optics based techniques for biomedical applications.

Dr. Manu Vaishakh
Assistant Professor
ISP-CUSAT

Intensity Modulated Earth-Satellite Free Space Optical Links

As the American theoretical physicist and cosmologist, Lawrence Maxwell Krauss has said "Aside from communication satellites, space is devoid of industry". Free space optical (FSO) communication technology can completely transform the mode of data transfer between these satellites and earth stations. In comparison to the radio frequency (RF) technology, that is being currently used, FSO technology offers higher data rate, enhanced security, license free spectrum and reduced mass, volume and power requirements. In addition to earth-satellite communication links, the highlighting features of FSO technology makes it a prospective technology for several other applications such as terrestrial, space, indoor, under water and chip-to-chip communications. However, there are certain constraints that limit the performance of FSO links. These are stringent alignment and pointing requirements, need for proper line of sight path between the transceivers, interference from background radiation and various atmospheric channel factors such as presence of haze, fog, clouds, turbulence, etc. The atmospheric effects can be mitigated by choosing an effective and an efficient modulation scheme and by using techniques such as diversity (in space, time or frequency), error control coding, adaptive optics, etc.



The FSO link from an earth station to a satellite, called the uplink, is modeled using spherical wave model and the satellite-to-earth FSO downlink using the plane wave model. This is owing to the fact that for the uplink the beam encounters the atmosphere near to the transmitter at the beginning of the propagation path and for the downlink it is near to the receiver at the end of the propagation path. An intensity modulated optical carrier carries the information from the transmitter to the receiver, which in this case is a direct detection (DD) receiver using a p-i-n (PIN) photodetector.

Among the various atmospheric effects, it is turbulence that is quite troublesome. Turbulence is characterized by the presence of air pockets of varying index of refraction, called eddies or vortices. It is induced by temperature and pressure fluctuations and results in beam wander, scintillation or spreading. Beam wander is the deflection of the beam from its original path caused by eddies larger than the transmitted beam size. This may cause beam wander induced pointing error. On the other hand, eddies smaller than the beam size causes beam spreading resulting in the broadening of the beam and reduction in the received power density. Beam scintillation caused by eddies of sizes comparable to the optical beam size leads to intensity fluctuations and subsequently reduction in the signal to noise ratio (SNR) at the receiver end.

The probability density function (pdf) of the intensity fluctuations caused by turbulence can be modeled using gamma-gamma turbulence model that is valid over the entire turbulence regime varying from weak to strong turbulence. The strength of turbulence is measured by a parameter called the refractive index structure parameter. For earth-satellite links this parameter is determined using the Hufnagel Valley Boundary (HVB) model.

To a good extent a robust modulation scheme can mitigate the effect of atmospheric turbulence on the performance of the FSO uplink and downlink. The modulation scheme of choice should be power efficient, bandwidth efficient, reliable in transmission and simple in implementation. The possible schemes are intensity, frequency, phase and polarization modulations. Among these, intensity modulation (IM) scheme is the most widely used one in FSO systems due to its simplicity, ease of implementation and cost effectiveness. same duration represents bit '0' in OOK scheme. In *M*-PPM scheme, the position of the pulse within the symbol duration holds the information. *M*-DPPM is the differential or truncated version of *M*-PPM scheme, wherein the empty slots within a symbol duration following the pulse is removed. Here the position of the pulse is determined with respect to the previous pulse. Because of this inherent symbol synchronization capability, *M*-DPPM requires only slot synchronization unlike the *M*-PPM scheme that requires both symbol and slot synchronizations

We evaluate the bit error rate (BER) performance of an FSO uplink and a downlink in presence of atmospheric turbulence. The performance is compared for three IM schemes namely, OOK, 64-PPM and 64-DPPM as shown in Figure 1. The wavelength of operation is 1550 nm and the satellite altitude is 38,500 km. It is observed that for a given average received power, 64-PPM scheme gives the least BER followed by 64-DPPM and OOK schemes. The trend remains the same for both the uplink and downlink. This can be attributed to the fact that for a given average received power, the peak to average power ratio (PAPR) and hence the instantaneous pulse power is highest for 64-PPM than 64-DPPM and OOK schemes. This makes the PPM pulse more immune to the effect of atmospheric turbulence. However, the improvement in the link performance is at the cost of the increased receiver bandwidth. For a bit rate of 1 Gbps, the required bandwidths for OOK, 64-PPM and 64-DPPM schemes are 1, 10.67 and 5.42 GHz, respectively.

Further, on comparing the performance of the uplink and downlink, the downlink performs better than the uplink. The presence of beam wander and hence the beam wander induced pointing error causes the additional degradation in the uplink performance. In the case of downlink, since by the time the beam reaches the earth's atmosphere, its size would have become larger than the turbulent eddies making the beam wander effect negligible.

Thus, although FSO technology is a feasible alternative for data transfer between an earth station and a satellite, the presence of atmospheric effects can serve as a hindrance in achieving the desired level of performance. The selection of a robust modulation scheme is a good way to mitigate the atmospheric effects and improve the link performance. Among the IM schemes, 64-PPM scheme with the highest value of PAPR and hence the instantaneous pulse power gives the least BER in presence of atmospheric turbulence followed by 64-DPPM and OOK schemes. Hence, PPM scheme would be a viable modulation scheme of choice for earth-satellite FSO links.

Anjitha Viswanath
Assistant Professor (On Contract)
ISP, CUSAT

"Everything You Go through, Grows You"- Insiders Investigations

Energy transfer from a dye donor to enhance the luminescence of Cadmium Sulfide Quantum Dots

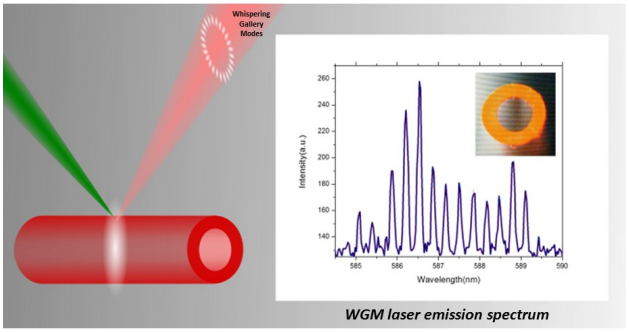
Ms. Alina C

Quantum dots (QDs) are well known for their optical properties which differ from those of bulk. Semiconductor nanocrystals are QDs typically 1 - 10 nm in diameter, consisting of a combination of elements from II-VI and III-V semiconductor nanomaterials. They have several advantages based on their optical properties like broad excitation spectra, photostability and size-dependent emission, which find applications in in-vivo, cellular and tissue imaging. In the context of biosensor applications, energy transfer between QDs and dyes has been extensively studied. If dyes are able to donate energy to QD acceptors, efficient Fluorescence Resonance Energy Transfer (FRET) could be achieved. However, most of the investigations are based on QDs as donors to dyes and the ability of QDs as energy acceptors from dyes has been questioned. The interaction between CdS QDs and dye molecules has attracted increasing attention because of their useful applications in extending their absorption range and also in many fields such as NLO, photonics and optical sensing. Energy transfer may occur if the donor-acceptor pair is in close proximity and the energy transfer can be of either radiative or non-radiative type. Förster (Fluorescence energy transfer) is a non-radiative energy transfer process which occurs as a result of dipole-dipole coupling between donor and the acceptor. The rate of energy transfer depends on the extend of spectral overlap and the distance between the donor and acceptor molecules (1-100A0). Because of the simplicity in building ratiometric fluorescent systems using FRET mechanism, the research interest in this area has significantly enhanced.

Mr. Anand V R

Whispering Gallery Modes (WGM) are specific electromagnetic resonances occuring in circularly symmetric structure and trap light in a circling orbit via total internal reflection. That microresonators such as microspheres, microdisks or microrings exploiting the confinement of light beams, are constituted by dielectric structures having circular symmetry, which sustain the so-called Whispering Gallery Modes. Organic materials can be considered as good material for the photonic circuit applications because of its low cost and mechanical flexibility.

Polymer microfiber with cylindrical shape and circular cross section have WGM resonance with high quality (Q) factor and small mode volume and is therefore a good candidate for the low threshold laser. Multimode Laser emission from whispering gallery has been reported from dye-doped hollow PMMA microfiber ,graded-index and dye doped polymer coated optical fibers etc. The dye doped hollow polymer fiber is drawn from hollow dye doped PMMA preform. Left half of the figure showes the schematic of WGM inside a dye doped hollow fiber, right inset shows the cross sectional view of HPOF with diameter of 230 µm. The dye (Rh B)doped H-POF is pumped transversely using a Q- switched Nd:YAG laser (532 nm, 10 Hz,8 ns) and the emission intensity is recorded with a CCD spectrometer having the resolution of 0.03nm. The first order WGM was observed from the lasing spectrum. The observation of first order WGM in the experiment will find useful applications in refractive index based sensing and tunable lasers.



WGM laser emission spectrum

STUDIES ON CERTAIN DYES FOR OPTOELECTRONIC APPLICATIONS

Ms. Anitha Prakash

The enormous potential and utilization of different dyes for various researches makes its use for diverse applications in the field of optoelectronics. Different types of dyes such as natural and synthetic dyes are utilized for such research purpose. Among the different types of dyes, because of the properties such as availability, the ease with which structural modifications can be made and compatibility made organic dyes more attractive. The organic dyes can also be used as solid state host materials. These properties make the field wide open for further research.

The most important aspect on these dyes is their application as lasing materials. These organic dyes can be used as laser active material and are tunable in a wide spectral range. The thermal and photochemical stability of dyes is of utmost importance for laser applications. Nonlinear optical characterization of organic dyes is another area which currently draws attention of many research groups due to its widespread applications. Fluorescent dyes and fluorescence spectroscopy are attracting much interest in the areas of research and development in basic and applied sciences like material science and molecular biology etc.

Number of researches is going on organic dyes for developing novel materials which can be used for applications such as optical power limiters, optical logical gates, optical communication, optical data processing, DSSC and many other related fields.

Fibers in present generations

Mr. Arindam Sarkar

We know the potential of fibers as a communication media. Our present generation communication is highly dependent on fibers. Most of the main servers we use during our internet surfing are situated many hundreds to thousands kilometre away from us. It is these optical fibers making it possible to communicate fast with very high bandwidth. Even our homes and offices now are getting connected with passive optic networks (PONs). But there are some other important applications started to be developed with fiber. One such application is photonic bandgap material and supercontinuum sources with photonic crystal fibers (PCFs). Supercontinuum sources also produced with rare earth doped fibers especially in infrared region (IR). Other than that fiber based lasers with single mode and multimode operations are also produced in last one decade. Based on many modifications such as doping, structural difference many interesting enhancement and quenching properties are demonstrated. Whispering gallery modes (WGM) generated in fiber lasers has found different applications including sensing. One of the emerging field are with fiber research is optomechanical cavity with fiber or coupled fibers. Fibers are being used in different medical diagnostics and medical operations. One of the recent developments in optical fiber is nanoparticle doped and coated fibers. These fibers can be useful for random lasing and more precise sensing operations. Fiber grating based sensors is also widely explored now. Since fiber dimensions can be ~10-200 μm (depending on the type) it has a huge potential for making portable devices which can be used in various applications in daily life. In our research laboratory many such opportunities are being explored.

SOLUTION CASTING: A TROUBLE FREE ROUTE IN CHALCOGENIDE PHOTONICS

AJINA. C

Chalcogenide glasses, the family of amorphous materials, containing at least one of the chalcogen group elements Sulfur, Selenium or Tellurium, are well known in diverse fields of photonics, medicine, environmental, sensors and security, owing to their tremendous properties such as, broad infrared transmission, high refractive index and optical nonlinearity. When it comes to device fabrications, conventional methods such as vacuum coating (thermal evaporation, chemical vapor deposition or sputtering) or pulse laser deposition were only used. These deposition methods require sophisticated instrumental facilities and also fail when it comes to the design of complicated shapes or structures of special dimensions. In such situations, solution-based methods, which involve the dissolution of chalcogenide glasses in solvents and processing as a liquid, comes handy.

Solution-based processing of chalcogenide glasses for optical applications was first explored by Chern et al. in the early 1980s. Even though their work on chalcogenide photo-resist met moderate success, the simplicity, low cost and resulting chemically homogeneous films as compared to traditional approaches motivated other researchers to follow this path. Among the different solvents analyzed, amines are found to be a promising one. Not all Chg.-amine system will provide good quality films. An appropriate solvent should be the one which will easily dissolve the glass and provide a good quality film and at the same time, it should be completely removable from the structure by annealing at temperature below glass transition temperature. The solvent removal is very important not only because the presence of low index solvent reduces refractive index of the film but also increases the risk of film degradation due to hydrolysis of amine group by moisture from atmosphere. So identifying proper glass/amine system is very important. In our studies we make use of this easy solution processing method for fabricating IR sensor platforms. Fabrication route of two such structure is given in figures. Figure 1. represents fabrication of microchannels in ChG by capillary actions in PDMS molds and figure 2 represents 3D photonic crystal fabrication from opal template.

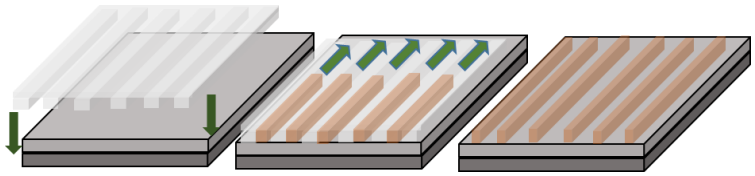


Figure1. Forming ChG structures by capillarity. PDMS mold placed on substrate, forming channels. Glass solution pipetted to inlets. Channels fill by capillary action.

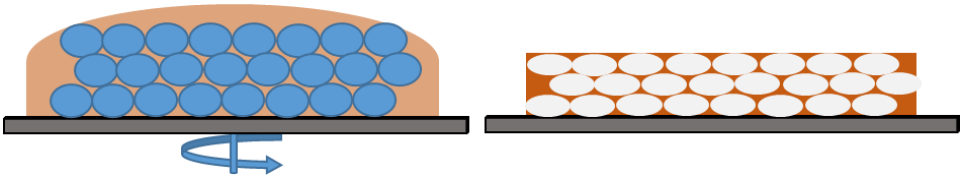


Figure 2. Scheme of solution-based preparation of the inverse opal chalcogenide photonic structurevia the silica opal film template and the spin-coating of nano-colloidal solution of the chalcogenide glass.

Two-photon Fluorescence Light Microscopy

Ms. Bini Pathrose

Two-photon excitation (TPE) microscopy is a widely-used imaging technique in medicine and biology for deep tissue and in vivo imaging applications. Because of the infrared wavelengths that are used, high penetration depth can be achieved in the case of scattering samples and a reduced photo damage in living specimens. TPE is a nonlinear optical process proposed theoretically by Maria Goppert-Mayer in 1931. In TPE, a fluorophore is excited via simultaneous absorption of two-photons, each having twice the wavelength (half the energy) required for the transition from the ground to the first singlet excited state. Specialized excitation sources with a timescale of molecular light absorption ~10-16S and high laser fluxes (>108W/m2) are the essential requirements for this simultaneous absorption. A mode-locked femtosecond laser emitting infrared light pulses is a best prerequisite in an efficient manner.

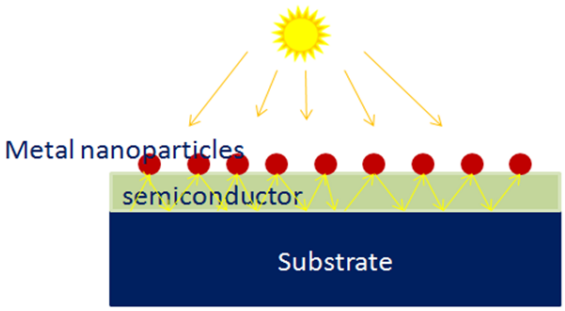
Fluorescence derived from one photon absorption exhibits a linear dependence on excitation light intensity, whereas the fluorescence from two-photon absorption shows a dependence on the square of the excitation light intensity. The application of TPE to fluorescence microscopy can be considered as a path-breaking achievement and was initiated by Denk, Strickler and Webb in 1990. TPE produces photo damage and photo bleaching effects within the confined excitation volume for the samples under

Plasmonic Solar Cells: The Future Solar Energy Harvesters

Ms. Hajara

One of the greatest challenges we are facing today is the need for low-cost, environmentally friendly energy sources that can meet the growing demands of an expanding population. Solar energy has the potential to contribute for the energy crisis problem. The Solar cell is a device that converts sunlight energy directly into electricity by the photovoltaic effect.

Solar cells can be divided into three different generations. Silicon solar cells with thickness 200-300 µm comes under the first generation and 90% of current solar cells is based on this. But the high cost of this solar cell module constrains its application and half of the cost of such solar cell is due to the thick silicon wafers. The Second generation is based on thin film technology, in which thin layer of semiconducting material is deposited on cheap substrates. It was an attempt to reduce the quantity of material and also to increase the efficiency. But the ineffective absorbance is a major problem in thin film solar cell. The goal of third generation solar cells is to increase the efficiency using second generation solar cells (thin film) and using materials that are found abundantly on earth. It is important to trap the light inside the absorbing materials to increase the efficiency and experimental evidences hint plasmonic solar cells are the one of the major remedy for this.



Refractive index sensors for the detection and measurement of cholesterol based on tilted fiber bragg grating.

Bobby Mathews. C

Cholesterol, present in practically all cells is vital for its functioning. When in excess, cholesterol may cause a number of health problems. For this reason, cholesterol has become one of the main parameters to be determined in routine clinical, pharmaceutical, biomedical research and food processing laboratories.

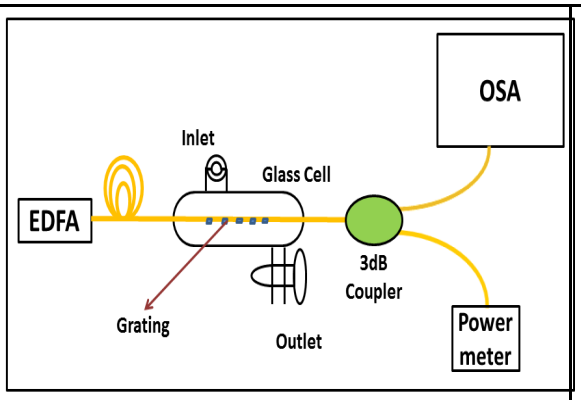
Recently, Optical Fiber Tilted Bragg Grating (TFBG) technology has gained great attention due to its numerous applications in fiber optic sensors. TFBG sensors have the advantage of intensity measurements rather than wavelength demodulation. TFBGs are short period gratings fabricated by creating periodic low and high refractive index bands along the core, inclined at an angle to the axis of the core.

The reflection from such a structure occurs in two well-defined wavelength bands, the bragg reflected core mode and the cladding modes. The tilted grating planes couple light from the fundamental core mode, backward to cladding modes, which get distributed at discrete wavelengths below the bragg wavelength. These contra-propagating cladding modes attenuate rapidly and are therefore not observable in reflected spectrum but are observed as numerous resonant loss bands in the transmission spectrum.

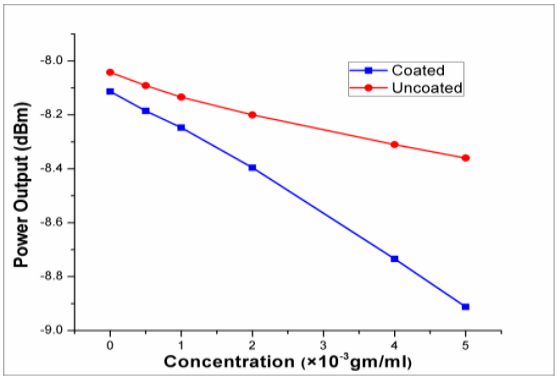
These cladding modes are highly susceptible to the changes in the surrounding refractive index (SRI) due to its dependence on the effective cladding index.The power transmitted by these resonant bands varies as the SRI changes, while the core-mode reflection from the TFBG remains unaffected by the SRI. Measurement of these variations in the transmitted power forms the basis of refractive index sensing with TFBG. TFBG based sensors for determining the total cholesterol have been designed and developed.

As the cholesterol concentration around the TFBG was increased, the refractive index of the surroundings also increased which in turn reduced the power transmitted. In order to enhance the sensitivity of the sensor head, a coating of chitosan was applied over the grating region. Chitosan is a biopolymer, which has affinity to cholesterol. As cholesterol gets attached to the chitosan layer, its refractive index changes, enhancing the sensitivity to SRI.

Light radiations from an EDFA was coupled to the sensor head and the transmitted signal was interrogated using an optical spectrum analyzer and a power meter. The schematic of the experimental setup and the transmitted power of the sensor heads, measured using the power meter, with and without coating for different concentrations of cholesterol is given below.



Block diagram of the experimental setup



Transmitted power of the sensor heads

The enhancement in the sensitivity of the coated cholesterol sensor head is evident from these plots and is attributed to the affinity of the chitosan biopolymeric coating to cholesterol. The instantaneous responses were also found to be linear in the measured range of cholesterol.

The TFBG sensor heads proposed have the advantage of power measurements rather than wavelength demodulation methods earlier reported. The power modulation characteristics can be utilized in designing cholesterol sensors for commercial applications with proper calibration. The sensor presented here provides a real time response and requires only a small volume of the sample for analysis. Features of the sensor, like simplicity and high sensitivity, make it recommendable for medical diagnosis and clinical applications for the detection of cholesterol concentration in humans with suitable modifications. The system can also be effectively used in the areas of biomedical sensing, drug development, etc. The wide range and linear response are the other attractive features of the developed sensor.

Insiders investigations

PHOTONIC CHLORINE SENSOR

Mr. Ishaq Ahmed

The guided wave optics, particularly fiber systems continue to offer unique possibilities in measurement context. A general fiber optic sensor comprises of optical sources, optical fiber, sensing or modulator element, optical detector and processing electronics. But 'all fiber sensors' have fiber itself as sensor element. Photonic sensors employ various kinds of modulation technique ranging from intensity type to index type (wave length type) modulation. A class of index modulated waveguide structures which includes bragg grating, long period grating, π-phase shifted grating, blazed or tilted grating and various types of chirped grating, revolutionized this arena.

The initial phase of study is undergoing on evanescent wave sensors. An important characteristic of guided mode which is particularly important for sensing devices is its spatial amplitude distribution. The interaction between propagating mode and the quantity to be measured (measurand) occurs through the evanescent field of the mode itself, namely its exponential decreasing tail.

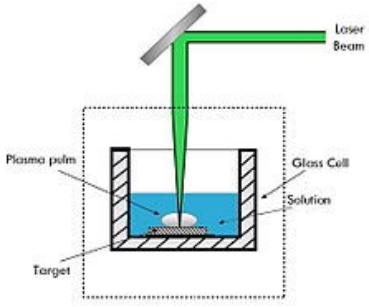
Optical fiber based evanescent wave absorption sensors utilize different designs for enhancement of sensor sensitivity and dynamic range of measurands. An investigation is undergoing whether to utilize the simple evanescent wave sensor technique for detection of amount of chlorine in drinking water. Chlorine is present in water as disinfectant and is added to water to destroy harmful bacteria and other microbial harmful organisms. But if its quantity is above the prescribed limit (usually above 5 ppm) then it causes water borne diseases to the human body. The reason behind this is that the chlorinated by-products such as "chlorinated hydro carbons" or trihalomethanes(THMs) are harmful for the human body.

A quite relevant technologies ranging from evanescent absorption spectroscopy to Surface Plasmon Resonance (SPR) technologies have been used in the literature for the design of photonic chlorine sensor. Current work is undergoing to design evanescent wave chlorine sensor using uncladded multimode silica fiber and to replace waveguide by using polymer as well as tapered silica fiber.

Synthesis and Characterisation of Metal Nanoparticles by Pulsed Laser Ablation

Ms. Jessy Simon

Laser processing of materials has become an important tool in many areas of technology. Laser radiation is used for welding, cutting, and drilling, and also for more exigent application such as production of complex surface patterns or modification of the physical or chemical microstructure of materials. In many applications, the removal of material from the surface of metals and semiconductors following irradiation with picosecond or femtosecond laser pulses called laser ablation, plays an important role. The ablation process depends on the thermal and optical properties of the materials and on laser parameters such as wavelength, laser intensity and repetition rate. The operating principle of this technique was introduced by Alan Gray in 1985. For direct analysis of the elemental composition of solids, mostly solid state lasers such as Nd:YAG laser systems operating at 1064 nm (fundamental wavelength) have been investigated. The advantages of laser ablation techniques over the chemical techniques include higher stability, dispersibility, purity, biocompatibility and lower toxicity. This method is being utilized for the preparation of various metal nanoparticles.

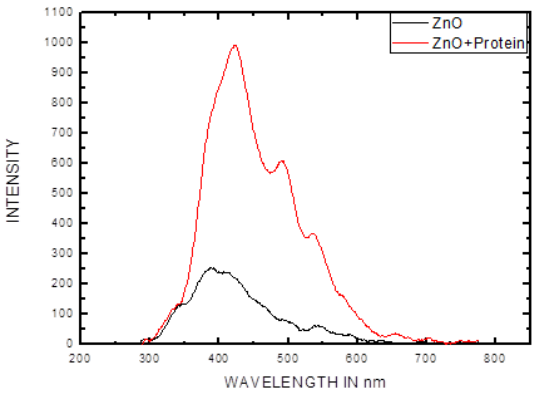


Laser Ablation setup

BIOMOLECULE ASSISTED SYNTHESIS OF SEMICONDUCTOR NANOPARTICLES

Manju Joseph

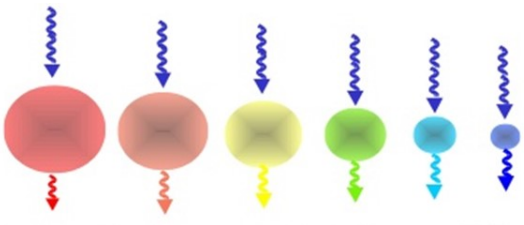
Advancement in nanotechnology enhances the uses of nanoparticle in detection, diagnosis, sensing and other bio-medical applications. Semiconductor nanoparticles exhibit unique photonic, electronic, and catalytic properties when functionalised with different biomolecules. These complexes are thought to be promising as novel intravascular probes for both labelling and medical treatment purposes. Protein assisted synthesis of ZnO nanoparticles were carried out and their potentials for antibacterial applications were explored.

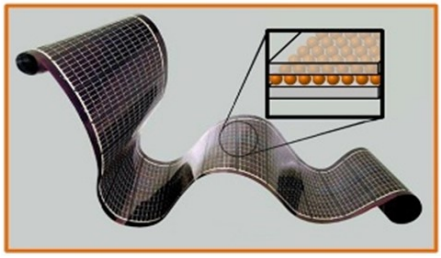


One of important milk protein casein is used in this preparation. The temperature induced structural changes in the milk protein-casein and difference in its solubility in the presence of ionic salt, sodium hydroxide were made use in this synthesis strategy. In this preparation casein plays a stabilizing role. However they will also show a significant influence in nanocrystal growth and in their photo luminescent properties. Casein added ZnO particles exhibit an enhanced fluorescence (as in figure). This fluorescence behaviour of the nanoparticle reveals their potentials for bio-labelling applications.

CdTe quantum dots and its applications

A quantum dot is a nanocrystal made up of semiconductor materials that are small enough to exhibit quantum mechanical properties. They are made of many of the same materials as ordinary semiconductors (mainly combinations of transition metals and/or metalloids). Researchers have studied applications for quantum dots in transistors, solar cells, LEDs and diode lasers. The main specialty of the quantum dots is the confinement effect. Its excitons are confined in all the three spatial dimensions. Hence it is a zero dimensional material. Quantum dots change color with size because additional energy is required to confine the semiconductor excitations to smaller volume.





There are several ways to confine excitons in semiconductors, resulting in different methods to produce quantum dots. Quantum dots are grown by advanced epitaxial techniques, or by ion implantation, or in nano devices made by state of the art lithographic techniques. Colloidal semiconductor nanocrystals are synthesized from precursor compounds dissolved in solutions, much like traditional chemical processes.

An immediate feature of colloidal quantum dot is their color. The larger the dot, the redder (lower energy) it's fluorescence spectrum. Quantum dots can be synthesized with larger (thicker) shells (CdTe quantum dots with CdS shells). The shell thickness has shown direct correlation to the spectroscopic properties of the particles like lifetime and emission intensity, but also to the stability.

Quantum dots may be able to increase the efficiency and reduce the cost of today's typical silicon photovoltaic cells. Quantum dot photovoltaic would theoretically be cheaper to manufacture, as they can be made using single chemical reactions.

Rare earth doped Nanoparticles for Photonic Applications

Ms.Pooja Gitty

Rare earths termed as "industrial vitamins" have numerous applications in industrial and technological applications. Recently, there has been a great deal of attention focused on rare-earth doped nanomaterials as a new class of nanomaterials with novel optical properties. Usually, Lanthanides (from Lanthanum through Lutetium in the periodic table of elements) are doped onto a host material. This provides unusual spectroscopic properties to the host material, arising from the shielding of 4f orbitals by filled $5s^2$ and $5p^6$ subshells of the trivalent lanthanides. Their fascinating optical properties are employed in lighting devices (economical luminescent lamps, light emitting diodes), television and computer displays, optical fibres, optical amplifiers, lasers, as well as responsive luminescent stains for biomedical analysis, medical diagnosis, and cell imaging.

One of the most active fields of the research in the past decade has been the development of rare-earth based nanoparticles, whose optical properties and low cytotoxicity are promising for biological applications. Attractive properties of rare-earth based nanoparticles include high photostability, absence of blinking, extremely narrow emission lines, large Stokes shifts, long lifetimes that can be exploited for retarded detection schemes, and facile functionalization strategies. Rare-earth based nanoparticles have been used for DNA detection (Cerium and Terbium). Lanthanide chelates or cryptates (mostly Europium) are commercially distributed as an improvement to conventional ELISA. Lanthanide nanoparticles are promising donors in LRET experiments. They are also employed in non specific imaging, specific protein targeting, single protein tracking, and contrast agents for MRI imaging. The sharp line like emission and the other potentialities of rare-earth based nanoparticles have to be exploited in exploring more applications in the field of Optics.

Nickel Oxide Nanoparticles for optoelectronic applications

Mr. V Pradeep Kumar

Transition metal oxide nanoparticles are rarely explored in the field of Optoelectronics. The Nickel oxide [NiO] is a wide-band-gap material with an energy gap larger than 3 eV. It is a p-type semiconducting transition compound, having the tunable crystalline size and optical bandwidth. The controlled conductivity makes NiO nanoparticles to use as a transport conductive oxide layer in the p type dye sensitized solar cell recently. Several synthesis methods are employed for the preparation of NiO nanoparticles such as sol gel method, laser ablation, hydrothermal and MOVD.

NiO nanoparticles were synthesized by sol gel process and investigated it's the variation of crystalline size, morphology, optical emission with respect to the variation of concentrations of precursors. As the Ni concentration increases, the morphology of material transforms from sphere to rod shape which is shown in the figure. The NiO became agglomerated when the Ni concentration is twice the oxygen concentration because of the higher surface energy. The reduction in the particle size is identified with respect to the increase of Ni concentration and observed blue shift phenomena in the emission spectrum. It is also evident that the emission is in the blue region. The UV absorption characteristics have also been investigated and it is found that the absorption extends into the visible region. The emission and absorption spectrum of the nickel oxide nanoparticles shows that the material is suitable for fabrication light emitting diode and solar cell.

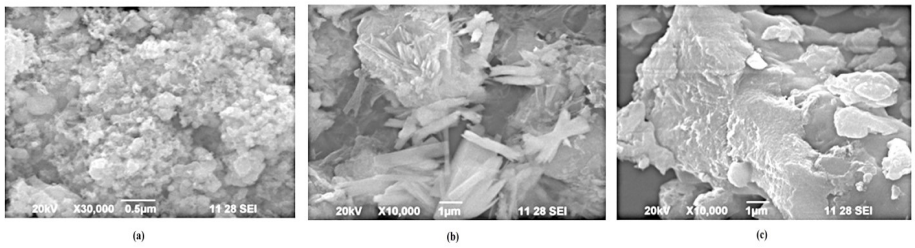


***Figure**. SEM images of NiO nanoparticles prepared with different molar ratios*

Effect of Silver Metal Complexes in the Medicinal Property of Herbal Tea Floral Extracts

Ms. Priyamvada V C

The corrosion of the silver is recently reported in the presence of glucose in aqueous medium. The studies based on this report are gaining momentum in finding out a green extraction method for silver nanoparticles, the effect of silver metal complexes in food and beverages etc. Optical and evanescent wave absorption studies can be utilized to effectively analyze the effect of silver in food and beverages in the presence of glucose.

In this regard, experiments are conducted to verify the corrosion of silver in water in the presence of glucose and its effect in the medicinal properties of certain red tea samples. The floral extract of the herb Roselle (*Hibiscus Sabdariffa)* having excellent medicinal properties is used for the experimental studies. This herbal extract is commonly consumed as red tea. Optical absorption spectrum of Dextrose is found to be significantly varying when treated with silver. Absorption bands corresponding to silver metal complexes are appearing on treating the water with silver and dextrose at about 70°C. When the Roselle floral extract is treated with silver and glucose in the preparation of red tea, significant change in the optical absorption spectrum and fiber optic evanescent wave absorption characteristics is observed. The medicinally important ingredient in the red tea is Anthocyanins and its optical absorption peak corresponds to 275nm. On adding silver and dextrose while preparing the red tea, the peak corresponding to 275nm disappears and an enhancement is observed in the absorption at 345nm. This experimental result points to the fact that the silver metal complexes can alter the medicinal property of the herbal extracts. The detailed study on this particular effect can lead to different applications in bio as well as chemical samples.

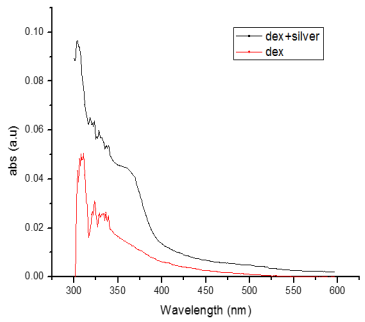


FIGURE 1. Dextrose absorption spectrum in the presence of silver

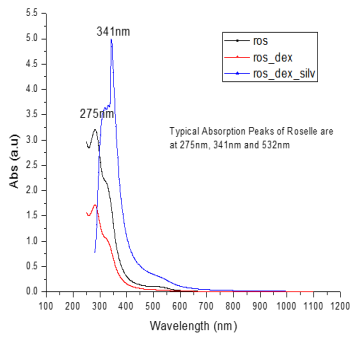


FIGURE 2. Roselle (*Hibiscus Sabdariffa)* Floral extract absorption spectrum in the presence of dextrose and silver

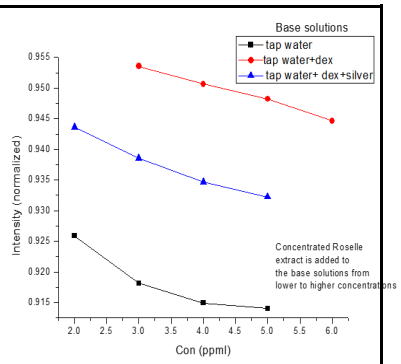


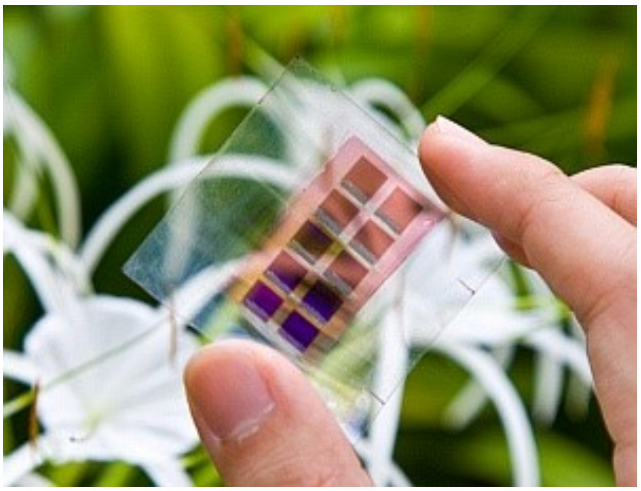
FIGURE 3. Evanescent wave sensing studies of the floral extract in the presence of dextrose solution with silver content

Chalcopyrite based photovoltaic devices.

Mr. Raj sha M

The level of CO2 content of the atmosphere is 406.66 ppm on January 31, 2017, is very high compared to the pre-industrial revolution level of 270 ppm. Increasing the CO2 level is dangerous with respect to the global warming. In order to reduce the CO2 level and control the global warming, reduction in the conception of the fossil fuels and usage of renewable energy sources are recommended. The solar energy is one of the best options in the renewable energy sources.

Photovoltaics deals the direct conversion of solar energy to electricity. The first generation photovoltaic devices (solar cells) are based on crystalline silicon and which is commonly used in the solar panels right now. The second generation photovoltaic cells are based on thin film technologies, that replace silicon from the absorbing layer with materials of higher absorption coefficient in order to reduce cost and attain more efficiency. Third generation photovoltaics devices are based on different technologies such as multijunction tandem solar cells, dye-sensitized solar cells, Quantum dot solar cells, Upconversion/ downconversion based solar cells, impurity band, Intermediate-band solar cells and perovskite solar cells etc.

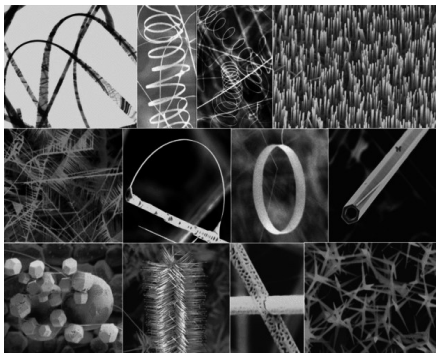


Chalcopyrites, predominantly Copper Indium Gallium Selenide/ Sulphide (CIGS) is direct bandgap material and a prospective candidate for the second generation thin film photovoltaic technologies. Because the material has a high absorption coefficient to strongly absorbs sunlight, a much thinner film is sufficient or the absorbing layer and thus cost can be reduced. The researchers are working on the more simpler manufacturing of the CIGS solar cell with more efficiency. However optimum ratios, thickness and methods for the manufacturing and have to select for the better performance. It is reported that small amount of metals like sodium, incorporation in the layer improves the electrical performance of Cu(In, Ga)Se2(CIGS) solar cells. Different researches going on the precursor ratios, better morphologies, nanotechnology assisted synthesis, solution processes and selenization process for more efficient CIGS solar cells. Investigations on the possibility of intermediate-band effects and subband absorption in the chalcopyrite materials carried out for third generation photovoltaics. International School of Photonics research team also thinking on this perspective if we could achieve interesting results in the intermediate -band effects. The improvements in the photovoltaic devices ultimately lead to the reduction of usage of fossil fuels and tackling of CO2 in a controllable manner.

Introduction to ZnO Nanostructures

Ms. Ramya M

ZnO is a promising wide band gap material having excellent chemical stability, non-toxicity, good electrical, optical and piezoelectric properties. This mateial also possesses a rich family of different morphologies, such as nanowires, nanotubes, nanobelts, nanocombs, nanosprings,nano rings, nanobows , have been synthesized under specific growth conditions. These unique nanostructures unambiguously demonstrated that ZnO is probably the richest family of nanostructures among all materials, both in structures and properties. The-nanostructures could have novel applications in optoelectronics, sensors, transducers and biomedical science. Properties of ZnO nanostructures strongly depend on its morphology and shape. So it is very essential to control their size, shape and surface architecture to utilize its properties in different practical fields. Many methods have been applied for the synthesize of ZnO nanostructures, such as MOCVD, Electrochemical deposition, Sputter deposition techniques and Pulse laser deposition method. But these methods requires sever reaction conditions, such as high temperature, accurate gas concentration. So it is very essential to find a simple, low cost method for the synthesis of ZnO nanostructures and controlling the growth parameters. Compared with the above synthesis process, hydrothermal method is simple and low cost to produce the different nanostructures. There are several parameters in hydrothermal such as temperature, time, concentration and pH that affect the growth of the ZnO nanostructures. A significant number of works are currently progressing for the synthesize of different morphologies and used it for different applications. Here we are trying to synthesis the different nanostructures of ZnO using different precursors and simply tuning the growth parameters, by hydrothermal method.



Fluorescence life time studies of LDS 821 dye with DNA

Mr. Sony U

Time-resolved fluorescence spectroscopy is a sensitive technique for studying the conformational changes occurring within DNA both in chemical and cellular systems as it interacts with intercalating and/or groove binding drugs. There are fluorescent probes available with binding properties analogous to many anti-neoplastic agents used in chemotherapy; these therefore represent a useful model with which to study the binding interactions of such drug molecules with DNA. Fluorescence lifetime analysis (FLA) allows the quantitative resolution of discrete fluorescence lifetimes from a fluorescence decay curve, which may reflect different domains or molecular interactions of the probe within a particular target macromolecule. Fluorescence life-time studies of the samples was done using Time-correlated single photon counting (TCSPC) method. The TCSPC is a simpler method to measure the life time of the sample with enhanced quantitative photon counting compared to other life time measurement techniques. . In the current study the interaction of LDS 821 and DNA in solution has been measured with this technique. The fluorescence decay curve of LDS 821 in ethanol is found to be mono exponential with an average life time of 507ps indicating the presence of non-radiative rotation of the molecule in the excited state. As DNA-CTMA is added to LDS 821 dye, the decay becomes multi exponential i.e., it contains two fluorescence lifetime components. As the amount of DNA-CTMA increases, the average life time of the samples are increased. The average lifetime of LDS 821 in 0.1wt% of DNA-CTMA is found to be 953ps. Large increase in lifetime specifies that the torsional motion around the C=C in LDS 821 has been constrained due to the presence of DNA-CTMA. LDS 821 interact with DNA-CTMA through intercalation, the force that sustain the stability of DNA -CTMA-LDS 821 dye complex may be Vander walls, hydrogen bonding or charge transfer forces. This force will reduces the torsional motion of LDS 821 dye in the excited state, which leads to increase in average lifetime of the dye. The lifetime measurement of LDS 821 and LDS 821 with DNA-CTMA also confirms the reduction of TICT state.

Photonics materials for lasing and display applications

Mr. Vijesh K R

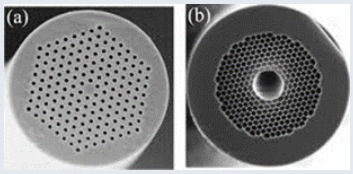
Photonics is expected to revolutionize many aspects of data collection, processing, transmission, interpretation, display, and storage. Development of new multifunctional photonic materials can improve the speed, encryption, storage and high resolution displays. Biomaterials are emerging as an important class of materials for a variety of photonics applications. DNA and Green fluorescence protein (GFP) are the important biomolecule for the photonic device application. DNA has its double helix structure and specific bonding between the strands of the structure. They have shown that good-optical-quality films of wave guiding quality can be fabricated using salmon DNA. They doped a laser dye into a DNA–surfactant complex film to achieve amplified spontaneous emission. GFP have been produced which exhibit different excitation and emission profiles. Some variants are blue FP, cyan FP, yellow FP, and red FP. They are being widely used as fluorescent markers in the determination of gene expression, protein localization, and protein–protein interactions .

I plan to work in the area of display devices in particularly Organic light emitting diodes (OLED). Basically an organic light-emitting diode (OLED) is a light emitting diode (LED) in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current. We have many challenges for our work in the area of OLED. Basically the electron ejection properties of cathode. Which is directly involved in the quantum efficiency of OLED. Commonly we use Al as the cathode and ITO as the anode. Because of the low work function initially use Mg and Ca as the cathode. Due to the air sensitivity it will changed to the new material such as LiF/Al. There are limited further work can be done to replace this material. No one can replace the anode as the ITO. There are lot work available based on the dye and nano particle based emissive layer in OLED. But the bio molecule based work has limited. Very few number of works based on the DNA as the emissive layer. But in the case of Green fluorescent protein, no work was done. Another important area of research is going to be in rare earth based OLEDs. In 1990 first rare earth OLED was fabricated with high brightness compared to the later works due to the carrier confinement the light emission become poor. The short life time is still continuous with unsatisfied. Because of that i would like to synthesize some nano particle based OLED to increase the luminescence efficiency and also the life time.

Chalcogenide Photonic-Crystal Fibers

Ms. Anupama V

Chalcogenide glasses are based on a mixture of chalcogen elements (sulphur, selenium, and tellurium) and other elements such as arsenic, germanium, antimony, or gallium. Compared to silica glasses, they offer several distinctive optical properties such as a transmission window that extends far into the infrared (IR) spectral region up to 25 µm. Chalcogenide glasses also exhibit an extremely high nonlinear refractive-index coefficient that can be two or three orders of magnitude greater than that of silica at 1.55 µm. Chalcogenide fibers present numerous applications in the field of photonics. Photonic crystal fibers (PCFs) are optical fibers that employ a microstructured arrangement of material in a background material of different refractive index. The unique properties of CHGs can be further enhanced by drawing chalcogenide glasses into photonic crystal fibers (PCFs) due to the possibility of designing such fibers with a very small core diameter. These newly developed fibers enable nonlinear active optical functions such as supercontinuum generation in the mid-IR and optical gates.



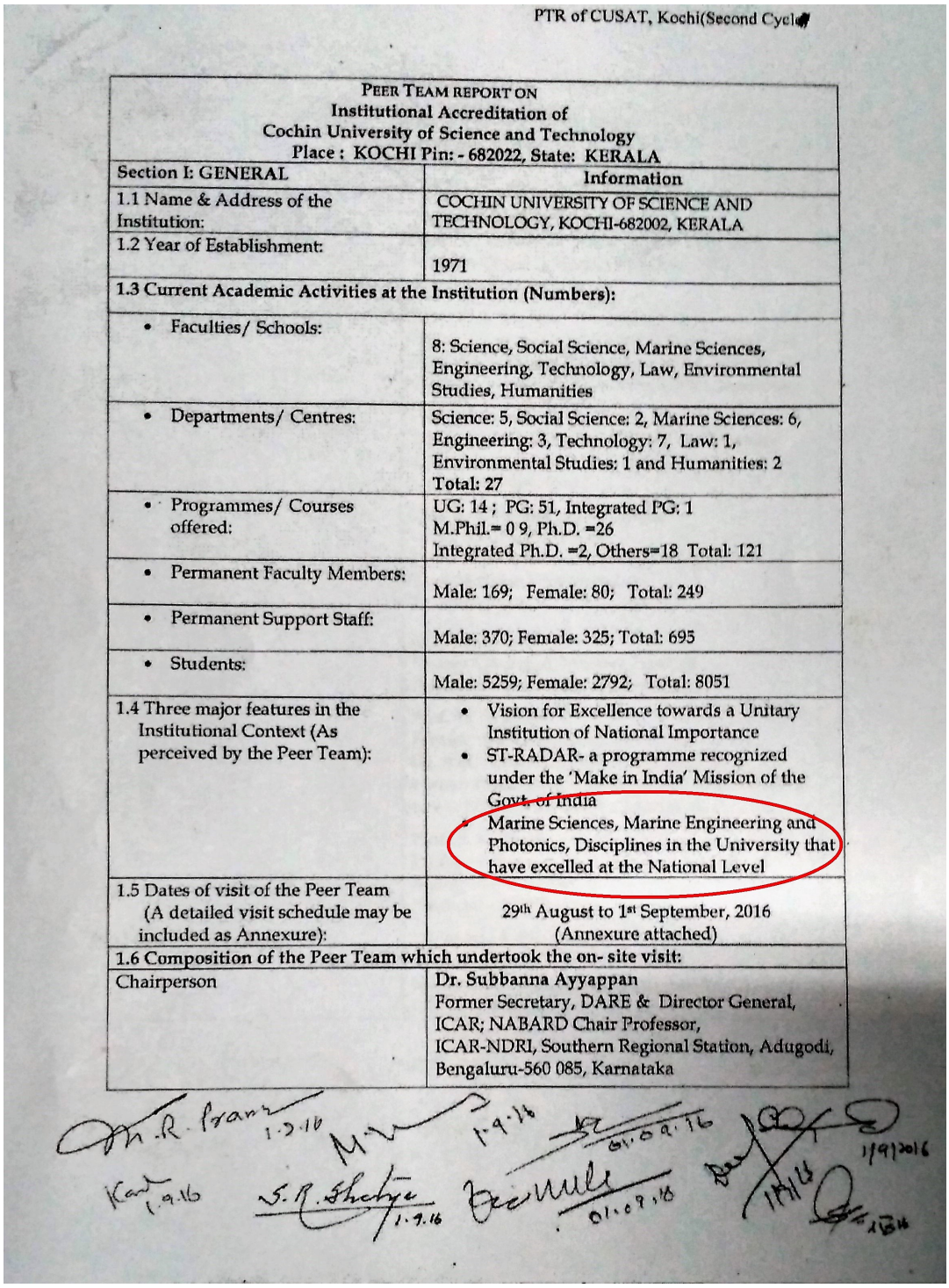
Typical (a) solid core and (b) hollow core PCFs

Photonic crystal fibers also exhibit several other interesting properties including endlessly single-mode operation, widely tunable chromatic dispersion, and single-mode guiding with a large effective area that can be extended into the mid-IR by using chalcogenide PCFs (CPCFs). In terms of passive optical functions, CPCFs should be useful for power delivery, nulling interferometry for space-based applications, and pollutant detection using optical sensors. Waveguide losses continue to be a challenge when using traditional manufacturing methods for photonic-crystal-based chalcogenide optical fibers, so new glass-casting methods are being devised that create fibers with high nonlinear coefficients.

ISP-An outstanding department of CUSAT

Our department as one of the most distinguished feature of CUSAT - As highlighted by the NAAC Team !!!

The National Assessment and Accreditation Council (NAAC) an autonomous body established by University Grants Commission assessed CUSAT and awarded A grade. In the assessment report the NAAC team cited International School of Photonics as one of the center of excellence in national level



PTR of CUSAT, Kochi(Second Cycle)

PEER TEAM REPORT ON Institutional Accreditation of Cochin University of Science and Technology Place : KOCHI Pin: - 682022, State: KERALA	
Section I: GENERAL	**Information**
1.1 Name & Address of the Institution:	COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY, KOCHI-682002, KERALA
1.2 Year of Establishment:	1971
1.3 Current Academic Activities at the Institution (Numbers):	
• Faculties/ Schools:	8: Science, Social Science, Marine Sciences, Engineering, Technology, Law, Environmental Studies, Humanities
• Departments/ Centres:	Science: 5, Social Science: 2, Marine Sciences: 6, Engineering: 3, Technology: 7, Law: 1, Environmental Studies: 1 and Humanities: 2 Total: 27
• Programmes/ Courses offered:	UG: 14 ; PG: 51, Integrated PG: 1 M.Phil.= 0 9, Ph.D. =26 Integrated Ph.D. =2, Others=18 Total: 121
• Permanent Faculty Members:	Male: 169; Female: 80; Total: 249
• Permanent Support Staff:	Male: 370; Female: 325; Total: 695
• Students:	Male: 5259; Female: 2792; Total: 8051
1.4 Three major features in the Institutional Context (As perceived by the Peer Team):	• Vision for Excellence towards a Unitary Institution of National Importance • ST-RADAR- a programme recognized under the 'Make in India' Mission of the Govt. of India • Marine Sciences, Marine Engineering and Photonics, Disciplines in the University that have excelled at the National Level
1.5 Dates of visit of the Peer Team (A detailed visit schedule may be included as Annexure):	29th August to 1st September, 2016 (Annexure attached)
1.6 Composition of the Peer Team which undertook the on- site visit:	
Chairperson	Dr. Subbanna Ayyappan Former Secretary, DARE & Director General, ICAR; NABARD Chair Professor, ICAR-NDRI, Southern Regional Station, Adugodi, Bengaluru-560 085, Karnataka

Awards-2016

Mr. Varun Raj

MSc Photonics (2012-2017)

Winner of OSA Student Chapter Competition Award for demonstrating "The Light Absorption Experiments", in the programme 'Frontiers in Optics-Laser Science 2016 'conducted by OSA at Rochester in New York, USA.

Ms. Bini Pathrose

Best Researcher award-2016

This award is endowed by Prof. P Radhakrishnan (Emeritus professor, CUSAT) to honor the best researcher of ISP based on Journal publications

Ms. Gayathri Reshma Sashidharan

Nalanda Endowment award-2016

For the topper in first semester M.Sc Photonics course. This award is endowed by Prof. N G K Devaki (Emeritus professor, CUSAT)

Ms. Divya Bharati

Ms. Geethika M

C V Raman award 2016

For the best project from Integrated M.Sc Photonics course. This award is endowed by Prof. V. P. N. Nampoori (Emeritus professor, CUSAT)

Ms. Neethu Udayan

Photonics Society of India award -2016

Satish John memorial Award-2016

For Getting the highest CGPA in M.Tech 2014-2016 Batch and for the best project

Alvin Varghese

Jeemol James

Achievers of **Erasmus Mundus - Scholarships** for students and academics | EACEA

M.Tech 2015-2017 Batch

NEW DOCTORATES FROM ISP

Nano materials with large third-order nonlinear susceptibility $\chi^{(3)}$ and ultrafast response have been under continuous scientific interest because of their potential applications for all-optical switching, light-controlled phase, refractive index modulation, and optical power limiting devices. In particular, TiO_2 has gained widespread acclaim for its prospective application such as, in dye sensitized solar cells, photo catalysts, gas sensors, electrochromic devices, biomaterials and so on. In this context, thesis has been devoted for the detailed investigation of TiO_2 and TiO_2 based nanocomposites materials. The early sections of the thesis presents the synthesis and characterization of TiO_2 and its important crystalline polymorphs. Work has been performed to study the morphology dependent optical studies of TiO_2 nanostructures. The work also concentrates on synthesis and detailed study regarding the material chemistry of different TiO_2 based nanocomposites. It is possible to tailor the linear and nonlinear optical properties of semiconductor by doping with other potential candidates. The last section deals with fabrication and characterisation of Dye Sensitised Solar Cells (DSSC).

Ms. Divya Sasi

Research Guide : Dr. A. Mujeeb

Among various optical sensing schemes, mid-IR sensors are gaining attention. The work reported in the thesis entitled "Investigations on selected chalcogenide glasses towards the realization of photonic devices" is focused on the fabrication and detailed analysis of different compositions of Germanium selenide based bulk, thermally as well as solution processed thin films of chalcogenide glasses, fabrication and characterization of silver island films and self-assembled monolayers (SAM) of anchor molecules for the realization of a prototype infrared (IR) sensor with chalcogenide glass (ChGs) as the sensor platform.

Ms. Indu Sebastian

Theoretical investigations of delay induced effects in semiconductor lasers with optical and optoelectronic feedback

Instabilities arising in semiconductor lasers when subjected to delay feedback are interesting phenomena because of their applications in fields like chaos based secure communication and the insight they provide into the basic physics of semiconductors. Delay systems generally exhibit very complex dynamics, and in the case of semiconductor lasers with delay feedback, the dynamics is unique because of the interplay between delay and different nonlinearities present in the active medium. We investigate different aspects of semiconductor laser dynamics when subjected to either optical or optoelectronic feedback.

Mr. Bejoy Varghese

Research Guide: Dr. V M Nandakumaran

Studies of deoxyribonucleic acid based photonic materials and their applications

Pradeep's doctoral thesis emphasize the use of natural 'green' materials especially hydrogen bonded molecules for optoelectronic and photonic applications. In his thesis, he has investigated one such material - deoxyribonucleic acid - and explored its applicability in (i) third-order nonlinear optical properties of dyes characterized by Z-scan technique, (ii) as a host material and fluorescence enhancer in a novel laser dye, (iii) and as a hole transporting layer and electron blocking layer in organic light-emitting diode. Over the past decade, DNA has made tremendous advancements in the field of optical science and technology and has emerged as a new field 'DNA Photonics' or 'DNA Biotronics'.

Pradeep Chandran C

Research Guide : Prof. V P N Nampoori

Thermo- Optic and Nonlinear-Optical studies on CdSe Quantum Dots for Photonic Applications

In general, linear- optic, thermo- optic and nonlinear- optical studies on CdSe QDs based nano fluids and their special applications in solar cells and random lasers have been studied in this thesis. Photo acoustic and thermal lens studies are the two characterization methods used for thermo- optic studies whereas Z- scan method is used for nonlinear- optical characterization. In all these cases we have selected CdSe QDs based nano fluids as potential photonic material and studied the effect of metal NPs on its properties. Linear optical studies on these materials have been done using various characterization methods and photo induced studies is one of them. Thermal lens studies on these materials give information about heat transport properties of these materials and their suitability for applications such as coolant and insulators. Photo acoustic studies shows the effect of light on the absorption energy levels of the materials. We have also observed that these materials can be used as optical limiters in the field of nonlinear optics. Special applications of these materials have been studied in the field of solar cell such as QDSSCs, where CdSe QDs act as the sensitizing materials for light harvesting. Random lasers have many applications in laser technology, in which CdSe QDs act as scattering media for the gain.

Anju K Augustine;

Research Guide : Dr.Kailasnath,

Laser Induced Linear and Nonlinear Optical Studies on Certain Metal Halides and Tartrate Crystals for Photonic Applications

Nonlinear optics is a broad field of research and technology that encompasses subject matter in the field of Physics, Chemistry, and Engineering. Among the different types of nonlinear crystals, metal halides and tartrates have attracted due to their importance in photonics. Metal halides like lead halides have drawn attention because they exhibit interesting features from the stand point of the electron-lattice interaction .These materials are important for their luminescent properties. Tartrate single crystals show many interesting physical properties such as ferroelectric, piezoelectric, dielectric and optical characteristics. They are used for nonlinear optical devices based on their optical transmission characteristics. Among the several tartrate compounds, Strontium tartrate, Calcium tartrate and Cadmium tartrate have received greater attention on account of their ferroelectric, nonlinear optical and spectral characteristics. The present thesis reports the linear and nonlinear aspects of these crystals and their potential applications in the field of photonics.

Rajeena I

Research Guide : Prof. P Radakrishanan

Investigation of thermal and nonlinear optical properties of metal nano-structures for photonic applications

The thermal and nonlinear optical properties of silver nanocolloids, silver nanorods and silver/titanium dioxide nanocomposites have been investigated in this thesis. Silver nanocolloids show a switch over behavior from saturable absorption to reverse saturable absorption depending on the excitation intensity. The underlying mechanism responsible for the observed behavior is the interplay between ground state plasmon band bleaching and excited state absorption. Nanofluids composed of rodshaped silver nanoparticles exhibit improved thermal properties in comparison with the base-fluid and nanofluids composed of spherical silver nanoparticles. This is explained on the basis of the empirical shape factor by Hamilton Crosser model. Several factors such as chemical environment, formation of nanolayer around the particle surface, nanolayer thickness and interfacial resistance are also considered to explain the results. The band gap tunability of TiO_2 nanoparticles have been achieved by depositing small amounts of silver nanoparticles on TiO_2 nanoparticles through laser light induced chemical reaction. We have used amorphous TiO_2 as as starting material for the preparation and the TiO_2 nanoparticles thus obtained are in pure rutile phase. The bandgap of TiO_2 nanoparticles have been tuned from 1.75-2.75 eV by varying Ag concentration. Another chemical method have been adopted to synthesize Ag:TiO_2 nanocomposites. The Ag:TiO_2 nanocomposites thus prepared exhibit enhanced nonlinear optical absorption compared to Ag and TiO_2 in their independent forms. Thermal diffusivity of the Ag:TiO_2 nanocolloids, increases with increasing volume fraction of nanoparticles in water and with increasing the temperature. We have demonstrated the lasing in random lasers fabricated by incorporating noble metal nanoparticles in laser dye/ polymer films. Gold or silver nanoparticles were the metalnanoparticle used and Rhodamine 6G was the laser dye chosen for random lasing studies. Threshold pump power for lasing gets reduced in the presence of metal nanoparticles. Mode structure with mode spacing of 0.2 nm in the case of Au/Rh6G/PVA film and 0.4 nm for Ag/Rh6G/PVA film was observed.

Misha Hari

Research guide: Prof. P Radakrishnan

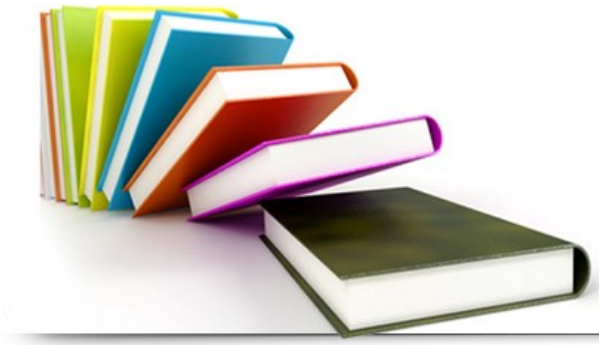
Prasobh Kumar P P of MTech OE& LT 2014 batch got shortlisted for 2017 GYTI (Gandhian Young Technological Innovation) national award for developing an image processing system to identify defective cocoons in mass producing silk worm farms. He is presently a PhD student of Optics and Microfluidics Instrumentation (OMI) Lab Indian Institute of Science ,Bangalore. His team has developed an automated cocoon quality assessment system for grading and pricing of cocoons based on the quality. This project demonstrates an innovative automated quality assessment system for cocoons, that offers significant advantages over the manual method in terms of accuracy, user friendliness, speed and cost effectiveness. The developed system consists of tandomly operated twin independent sections, namely image processing and sound processing. Image processing section consists of the conditioned illumination unit, image acquisition and processing unit realized with smart camera which acquires the images of cocoons in a given lot and assessing the cocoon quality by running the custom-made cross-platform image processing algorithms on acquired images.

Synthesis and Characterisation of Rare-Earth Nanomaterials for Biophotonic Applications

Dr. Mathew S

Post Doctoral Fellow

Rare-earth (RE) ion (typically trivalent) doped nanocrystals (NCs) have attracted great interest due to their narrow emission band widths, long luminescence lifetimes, biocompatibility, and nontoxicity giving rise to potential applications in diverse fields such as bio-imaging and solid-state phosphors for displays. To date, multifunctional NCs that exhibit two or more different properties arehighly desirable for many important technological applications such as multifunctional imaging, andsimultaneous diagnosis and therapy due to their versatile functionality. The Nd^{3+} ion with anabsorption around 800 nm is considered as a good candidate to achieve high downconversion (DC)quantum efficiency and significantly improve the penetration depth for deep-tissue imaging due tothe NIR DC emission around 850–1,100 nm. Besides, Nd^{3+} ions under excitation at 800 nm canalso overcome the overheating issues associated with the upconversion (UC) sensitizer Yb^{3+} ions underexcitation at 980 nm in the UC process. Yb^{3+} ions can play the role of energy-transfer bridging ionsbetween an energy donor (Nd^{3+}) ion and energy acceptor RE^{3+} ions (Er^{3+}, Ho^{3+} and Tm^{3+}) with emission in the visible region under excitation at 800 nm. Therefore, Nd^{3+} sensitized DC/UC dual-mode NCs combining the merits of both above mentioned Nd^{3+} doped DC systems and Yb^{3+}-Nd^{3+}-RE^{3+} UC systems at the same time are attractive because of their deep NIR light penetration, low thermal effects, and their ability to be observed with the naked eye or the widely available Si-CCD cameras attached to a microscope under a single excitation at around 800 nm. A recent study by Li et al. has shown that the DC signal from Nd^{3+} sensitized dual-mode nanomaterials can still be detected even from the back side of a mouse under excitation at 800 nm and the heating effect of 800-nm light is obviously lower than that of 980-nm light at the same power density. This proof-of-concept experiment suggested that the 800 nm excited low thermal effect UC/DC dual-mode nanoprobe not only can be used for NIR (800 nm)-to-visible (540 nm) in vitro bioimaging, but also shows great penetrationdepth at the “NIR biological window” in in vivo imaging. Moreover, when these fluorescent NCs areco-doped with gadolinium ions (Gd^{3+}), they are capable of being used as magnetic resonance imaging(MRI) contrast agents facilitating an excellent spatial resolution and depth for in vivo imaging. Currently we are in the process to synthesis and characterization of various rare earth metals (Nd^{3+},Gd^{3+}, Yb^{3+},



Recent publications from ISP

Journal Publications: -

1. Bini Pathrose, V.P.N. Nampoori, P. Radhakrishnan, H. Sahira, A. Mujeeb, Effect of femtosecond laser ablated silver nanoparticles in thethermo-optic properties of basic fuchsin dye, Optik 127 (2016) 3684–3687.
2. Bini Pathrose, V.P.N. Nampoori, P. Radhakrishnan, A. Mujeeb, Investigations on the third order nonlinear optical properties of Basic Fuchsin dye using zscan technique, Optik 127 (2016) 7717–7725.
3. Bini Pathrose, Nampoori VPN, Radhakrishnan P and Mujeeb A. Stability, Size and Optical Properties of Silver Nanoparticles Prepared by Femtosecond Laser Ablation, J Nanomater Mol Nanotechnol 2016, 5:3.
4. Bini Pathrose, V. P. N. Nampoori, P. Radhakrishnan, A. Mujeeb, Influence of Femtosecond Laser Ablated Silver Nanoparticles on the Nonlinear Optical Properties of Basic Fuchsin dye, Plasmonics, DOI 10.1007/s11468-016-0346-7.

Conference Publications: -

1. Optical limiting characteristics of Basic Fuchsin, Bini Pathrose, V.P.N. Nampoori, P. Radhakrishnan, A. Mujeeb, Published in the Proceedings of NPSAW, ISP, CUSAT, Cochin (February 2016).
2. Enhancement in the optical limiting performance of Basic Fuchsin dye in the presence of colloidal silver nanoparticles, National Laser Symposium (NLS-25), KIIT, Bhubneshwar, (December 2016).
3. Investigation of the herbal content of the commercially available Hibiscus tea by optical measurement methods, Priyamvada.V.C, Nisa Jacob, Swathy Krishna, Stephy Maria Francis, P.Radhakrishnan, National Laser Symposium (NLS-25), KIIT, Bhubaneshwar, Dec 20-23, 2016
4. Evanescent Wave Sensing and Absorption Analysis of Herbal Tea Floral Extracts in the Presence of Silver Metal Complexes, Priyamvada.V.C and Radhakrishnan. P, Optics'17 (National Conference on Optics), NIT Calicut, Jan 9-11, 2017
5. C L Linslal, S Mathew, M Kailasnath, "Strain Tuning of the Whispering Gallery Lasing Modes of a Hollow Polymer Fiber", International Conference on Fibre Optics and Photonics (Photonics-2016), Dec 2016, IIT Kanpur, India.
6. C L Linslal, V R Anand, M Kailasnath, "Amplification of the microlasing modes of polymer fibers", International Conference on Fibre Optics and Photonics (Photonics-2016), Dec 2016, IIT Kanpur, India.
7. C L Linslal, S Mathew, Anand V R, M Kailasnath, "Whispering Gallery Mode Lasing From Cladding Doped Polymer Optical Fiber", 25th DAE - BRNS National Laser Symposium (NLS-25), Dec 2016, KIIT University, Bhubaneswar.
8. Preliminary investigations on materials/metal structures using laser induced breakdown spectroscopy for underwater structural health monitoring, B C Mathews, K Bhavsar, T Thevar, P Radhakrishnan and R Prabhu, Intl. Conference on Material Science and Technology , ICMST 2016, Pala, Kerala, India 2016.
9. Design and Development of a Cholesterol Sensor Based on the Refractive Index Sensing of Tilted Fiber Bragg Grating; Bobby Mathews C, T. M. Libish, V. Vivek, Mathew.P. Abraham , P. Radhakrishnan; Proceedings Photonics 2016: International Con-

11. "Laser irradiated BSA-gold nanoparticle conjugates", Jessy Simon, C. Pradeep, S. Mathew, V.P.N. Nampoori, M. Kailasnath, NLS – 25, Bhubaneshwar, December 2016.
12. "Effect of gold nanoparticle concentration on BSA-gold nanoparticle conjugates", Jessy Simon, Sony U., V.P.N. Nampoori, M.Kailasnath, National Physics Symposium(NPS), St.Teresa's College, Ernakulam, February 2017.
13. Whispering Gallery Mode Laser Emission From Dye Doped Hollow Polymer Fiber, V R Anand, S Mathew, Jaison Peter, Boni Samuel, P. Radhakrishnan, M. Kailasnath, National Laser Symposium (NLS-25), KIIT, Bhubneshwar, 20-23 Dec, 2016
14. Colloidal crystal growth from silica nanospheres prepared by modified stober process Ajina c, Fathima shabana, Krishnendu ps, Sheenu Thomas, Optics 2017 Jan 9_11 NIT Calicut
15. Laser induced fluorescence from Curcumin doped silica xerogel, Roopa Venkataraj, Arindam Sarkar, M Kailasnath, NLS 25, KIIT, Bhubhaneshwar, Dec 20-23 2016
16. Curcumin Based Optical Sensing of Fluoride in Organo-aqueous Media Using Irradiation Technique, Roopa Venkataraj, P Radhakrishnan and M Kailasnath, Optics 17, NIT Calicut, Jan 9-11 2017
17. Boni Samuel, Retheesh R. and A. Mujeeb. "Development of a low cost and indigenous laser biospeckle technique for the detection and analysis of pesticides in vegetables and fruits". 29thKerala Science Congress. 28-30, Jan. 2017.
18. Boni Samuel, Retheesh R, A. Mujeeb and V. P. N. Nampoori. "Nondestructive evaluation of fruits using correlation of time history of biospeckle pattern". 26th National seminar and international exhibition on non-destructive evaluation. 15-17 Dec. 2016.
19. Correlation Between Thermal, Physical And Optical Properties Of Ge-Se-Sb Chalcogenide Glasses, V Anupama, C Ajina, Sheenu Thomas, Optics 2017 Jan 9-11, NIT Calicut
20. Studies on optical, linear and nonlinear properties of CdS quantum dots prepared by chemical method and microwave method, Alina C Kuriakose, V P N Nampoori and Sheenu Thomas, NLS – 25, Bhubaneshwar, December 2016.

New Comers

1. **Dr. Mathew S** Joined as a Post Doctoral Fellow . He is working on the "Synthesis and Characterisation of Rare-Earth Nanomaterials for Biophotonic Applications".
2. **Anitha Prakash** joined as a research scholar and she is working on the "Synthesis and characterisation of certain dyes for optoelectronics applications" under the guidance of Dr. A Mujeeb.
3. **Pradeep Kumar V** joined as a research scholar and he is working on the "Synthesis and characterisation of certain metal nano particles for optoelectronics applications" under the guidance of Dr. A Mujeeb
4. **Hajara P** joined as a project fellow and she is working on the "Investigation of doped copper oxide for p-channel thin film transistor application " under Dr. Saji K J (DST-SERB Project under Young Scientist scheme)

"Knowledge increases by sharing but not by saving"- Talks delivered by our resourceful faculties

Invited Lectures

Given below the list of lectures given by ISP faculties in different institutions during last year.

1.Prof.A. Mujeeb

1) 15th February 2017, International School of Photonics, CUSAT

Invited talk on "Photonics- Technology using light" in KSCSTE SPEED Programme for Pratibha Scholars- SIGN IN

2) Special Address at 26th National seminar & International Exhibition on Non-Destructive Evaluation during 15- 17 Dece ber 2107 at Thiruvananthapuram organized by Indian Space Research Organization (ISRO), Indian Society for Non Destructive Evaluation

3) Lecture on "Laser Assisted synthesis of materials" at UGC HRDC University of Kerala on 14th December 2016.

4) Invited talk "Experimental and Theoretical Studies on Electronic Speckle Interferometry for Non-Destructive Evalua tion" nCORTech16, LBS College of Engineering Kasargode, December 2016

5) "C V Raman : The Legend who placed India on World Science Map", during National science Day Celebrations at NSS College Karamana Thiruvananthapuram on 20th February 2017

Prof. (Emeritus).P.Radhakrishnan

16th February 2017, International School of Photonics, CUSAT

Invited talk on "Introduction to Lasers and their Applications" in KSCSTE SPEED Programme for Pratibha Scholars

Prof. (Emeritus).C.P. Girijavallabhan

15th February 2017, International School of Photonics, CUSAT

Invited talk on "Brief History of Science and Technology" in KSCSTE SPEED Programme for Pratibha Scholars

Prof.(Emeritus).V.P.N.Nampoori

15th February 2017, International School of Photonics, CUSAT

Lab (Hands on experience) for Pratibha Scholars

Prof.Pramod Gopinath

Invited talk on "Optical Sources and Detectors" on Modern Optical Engineering(27th June and 2nd July 2016)

Indian Institute of Space Science and Technology, Thiruvananthapuram

Prof. M. Kailasnath

15th February 2017, International School of Photonics, CUSAT

Invited talk on "Optical Fiber based Devices" in KSCSTE SPEED Programme for Pratibha Scholars- SIGN IN

Dr. Sheenu Thomas

16th February 2017, International School of Photonics, CUSAT

Invited talk on "Chalcogenide Glasses for Photonic Applications" in KSCSTE SPEED Programme for Pratibha Scholars

Dr.T.R.Ananthakrishnan, Visiting Faculty, International School of Photonics, CUSAT

16th February 2017, International School of Photonics, CUSAT

"Physics Theatre" (Demonstration of Physics Experiments) for Pratibha Scholars

Dr. Saji K J

1) March 18, 2016, National workshop on Nanophotonics, Department of Physics, CUSAT, "Two dimensional materials Field Effect Transistors",

2) Invited Talk on "Excitonic Solar Cells" in National Workshop for Contemporary Advances in Materials for Energy (CAME-17-10th February 2017, Physics Department, CUSAT)

Dr.Manu Vaishakh

1) "Analysis of optical imaging using the method of nonlinear dynamics", International conference on computing, commu nication and signal processing, College of Engineering, Karunagappally, July 8-9 2016

2) "Developments in optical microscopy: A historical perspective", Optics 17: A conference on light, NIT Calicut, January

THURSDAY SEMINAR

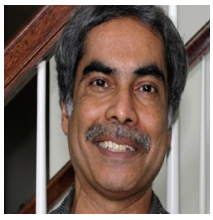
Weekly/special seminars are organized possibly on every Thursdays by ISP members or guests. These seminars were sponsored by the ISP Student's Chapters of SPIE– the international society for optics and photonics, Optical society for America and Photonics Society of India.

SNO.	SEMINAR TOPIC	PRESENTED BY
1	Simulation of material properties	Adrine Antony Correya
2	Axiomatic approach to Quantum Mechanics	Prof V.P.N Nampoori
3	Gravitational Waves	Prof C.P Grijavallabhan
4	How to publish more scholarly articles	Dr. Surendran Cherukodan
5	Study of protein- gold nanoparticle conjugates	Jessy Simon
6	Cancer cell imaging using protein modified cds QD's	Alina C Kuriakose
7	DNA bases-Thymine and Adenine for Bio-OLED	Sony U
8	Biosensing with plasmonic nano sensors	Priyamvada V C
9	Tuning whispering gallery mode lasing from self-assembled polymer droplets	Anand V R
10	Controllable synthesis and change of emission color from green to orange of Zno QD's using different solvents	Ramya R
11	Super-flat supercontinuum generation	Arindam Sarikar
12	Full color light emitting carbon dots with surface controlled luminescence mechanism	Vijesh K R
13	Lanthanide based resonance energy transfer between Ce doped LaPo4 nan rods and coumarin 440 dye	Pooja Gitty
14	How to prepare a winning research proposal view point of an expert evaluator	Prof Suresh C Pillai
15	Determination of chlorinated hydrocarbon in water using highly sensitive Mid-IR sen-	Ishaq Ahamed A
16	Measuring milk fat content by random laser emission	Anitha Prakash
17	Thermo-tunable hybrid photonic crystal fiber based on solution processed chalcogenide glass nano layer	Anupama V
18	Improved air stability of perovskite solar cells via solution processed metal oxide transport layer	Hajara p
19	Lanthanide doped multifunctional Nano materials and their photonic applications	Dr. G Ajith Kumar
20	Biophotonics	Dr. A Sreekumar
21	Ancient India- Scientific achievements and worldwide interaction	Dr Raj Vedam
22	3D micro printing by direct laser writing	Jerald Cleetus

Prof.Suresh.C.Pillai

Dr. G. Ajith Kumar

Dr. A Sreekumar



Dr Raj Vedam

INVITED DELEGATES FOR GUEST TALK

FIST and Other Funded Projects

FIST programme of DST

Duration **:** 5 years

Aim : To strengthens the post graduate teaching and research facilities in the department.

Fund : 95 lakhs

Project Name : Development of Laser Bio-speckle technique for monitoring biological activities of plants, vegetables and fruit

Principal Investigator **:** Prof. A. Mujeeb, Director, ISP, CUSAT.

Duration **:** 3 Year

Sponsor **:** KSCSTE

Fund : 16,03,000

Project Name : Chalcogenide Nanomaterials for photonic device applications

Sponsor **:** KSCSTE

Principal Investigator **:** Dr. Sheenu Thomas, Associate Professor, ISP

Duration of Project **:** 3years

Fund **:** 30,65,600

"MoUs with International Institutions"

Students form ISP are getting exposure in various international research laboratories as a part of their M.Sc/M.Tech Projects. Following is the list of Institutions where ISP students are presently doing their masters projects.

1. **Multimedia university,** Malaysia - A. Amith K , Abhishek Palmer (MSc, 2012-2017 Batch)
2. **University of Gothen berg,** Sweden - Jeemol James, Alvin Varghese (MTech-2015-2017 Batch)
3. **University of Aldo Maro**, Italy (MoU in Final Stage)
4. **Tampere University of Technology** , Finland– Abhishek Renjan (MSc,2012-2017 Batch)
5. **University of Toronto**, Canada– Ebin Joseph (MTech,2012-2017 Batch)

Recent Placements

Geethy Purushothaman

Optical Communication

Tech Mahindra

(M.Tech 2014-2016 Batch)

Faisal Khan

Optical Communication

Tech Mahindra

Abhijith A

George P Mathew

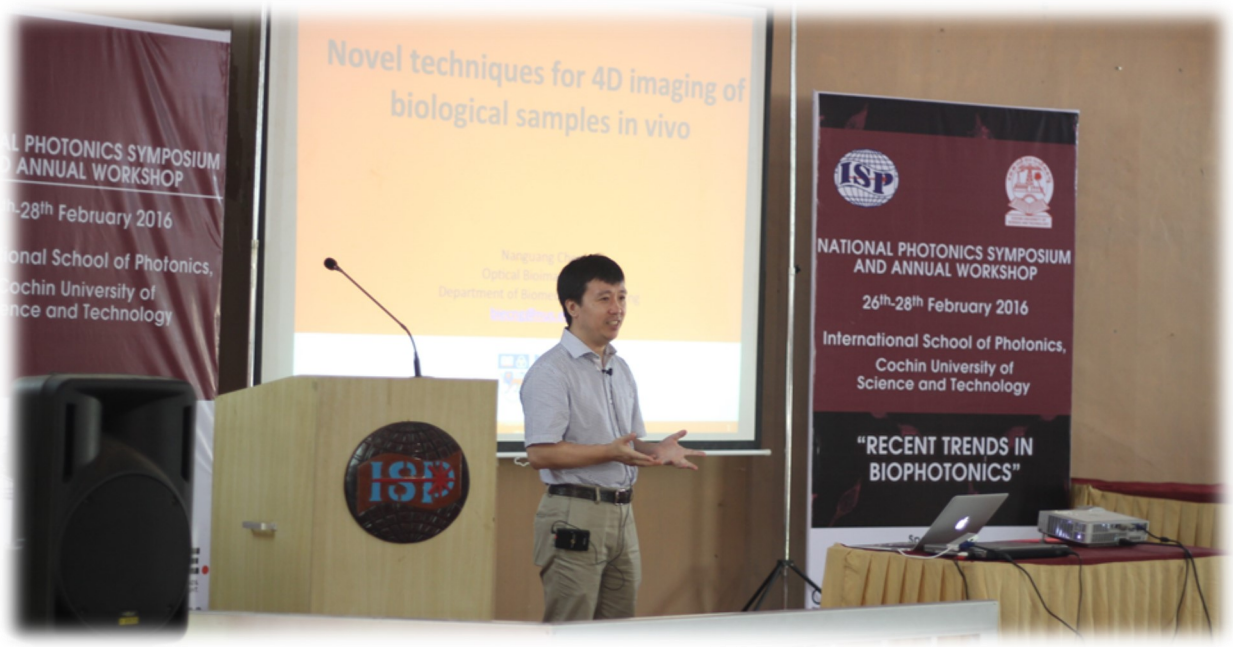
Design Engineer

SFO Technologies

(M.Tech 2013-2015 Batch)

Formidable Technical Programs Launched by ISP

National Photonics Symposium and Annual Photonics Workshop-2016



International School of Photonics, Cochin University of Science and Technology organized the 1st National Photonics Symposium and Annual Workshop, NPSAW-2016 on February 26th to 28th 2016. The focal theme of the workshop was "Recent trends in Bio-Photonics".Annual Photonics Workshop (APW) is a national event which brings together leading scientists, academics, industrialists and young researchers in the country for active discussions and fruitful interactions on various aspects of Photonics for the past 19 years. In the context of the ongoing celebrations of International year of light, the scope of APW edition for this year has been extended to symposium and workshop.

The inaugural function was held in the C.V. Raman Auditorium of the International School of Photonics at 9.30am on 26th February. The meeting was presided over by Dr. M. Kailasnath, Director, ISP who welcomed the gathering. Prof.Anil Prabhakar,IIT Chennai, inaugurated the Symposium. On this occasion, Photonics News, the annual news magazine from the department, was released by Prof. A. Mujeeb, Member of Syndicate, CUSAT. Prof.C P Girijavallaban and Prof. V P N Nampoori, Felicitated the Symposium. ISP Proudly distributed mementos, certificates and cash awards for the toppers of the M.Sc.Photonics and M.Tech Optoelectronics and Laser Technology courses, Best project presentations and Best researcher award were also distributed. Prof P Radhakrishnan, International School of Photonics thanked the attendees.

After the Inauguration of NPSAW-2016, Chen Nanguang, National University, Singapore gave the titular talk in "Recent trends in BioPhotonics". Followed by Dr. Anil Prabhakar, IIT Madras on "Photonics in Bio Engineering", Dr. S.K. Sreenivasan Nair on "High Power Solid State Lasers". For the morning session of 26th February 2016. The evening session was dedicated for paper presentations on various topics. Dr. Manoj V. Mathew on "Advances in Optical Sectioning Microscopy", Dr. Santhosh Chidangil on "Protein profile-based method for the early diagnosis of malignancy", Dr. R.S. Jayasree on "Spectral mapping and imaging for the early diagnosis of various diseases", Dr. N.V. Unnikrishnan on "Laser written Waveguides", Jithin Jose on "Listening to Laser Light" and Dr. Manoj A.G. Namboodiri "Bacteriorhodopsin its Photonic Applications" gave talks on 27th February 2016 which was followed by paper presentations. The day was concluded by a music session by Dr. Kailasnath and team members which included the research scholars of ISP.

The final day of the program, 28th February 2016, witnessed talks by Dr. Deepthy Menon on "Immunofluorescence labeling of cancer cells using quantum dots", Dr. Suresh Nair on "Mind to Market". The National Science Day as well as 20th birth day of International School of Photonics was celebrated on the same day with a talk by Dr. V.P.N. Nampoori on "DNA Photonics". dedicated to the Science Day. The later sessions had the rest of the presentations which had a total of 21 paper presentations.The workshop was concluded with a valedictory function chaired by the Director of International School of Photonics on 28th February at 3.45pm.

Optics Fair 2017

ETCHNEW is the annual Optics Fair held at ISP, CUSAT with the intention to promote and encourage optics and photonics. It is a platform where the younger students are given a chance to interact with the photonians thereby introducing a new outlet for scientific insurge into the world of photonics. Our department aims to give maximum exposure and knowledge regarding the various opportunities of career that is awaiting the new generation in the field of optics. ETCHNEW is held every year with the objective of bridging the gap between students and optics, allowing them to merge themselves into the magic woven with the phenomenal effects of light. Our major target is High School and Higher Secondary students so that they get a chance to admire the beauty of optics and get inspired to take up a path leading to the field of photonics in their future. ETCHNEW aims to enhance the gravity of experimental physics and let the students approach education with a new mind set, where their curiosity overrides the limiting barriers of book-restricted education system prevailing today.

ETCHNEW 2017 was held on 16th 17th January. Around 900 students from schools in and around Ernakulam district participated in the programme. The programme schedule included lectures and seminars by eminent professors on the topics dealing with the basic fundamentals of optics. The basics of electricity and magnetism were demonstrated by simple experiments in Electrostatics and Magentostatics. In addition to this experiments in Wave Optics and Ray Optics were demonstrated. The major highlights of Optics Fair 2017 were Physics Theatre, 3D Science shows, Li-Fi etc. All the experiments were classified into various sections depending upon the level of complexity.

Quantum Optics Lecture Series

The International School of Photonics- OSA student chapter organized a lecture series on Quantum Optics as a part of the Centennial celebration of OSA, The Optical Society. The lectures were given by eminent professors in the field of Quantum Optics. There was four set of lectures scheduled on four weekends with the first set of lectures were given by Dr. Andal Narayan, LAMP Group, Raman Research Institute, Bangalore on 1st October Saturday and 2nd October Sunday. Prof. K Thyaga-

Prof. K Thyagarajan
Department of Physics
IIT Delhi

Prof. Andal Narayan

Science to Ignite Inspirations (SIGN IN)

KSCSTE started the programme of Sastra Pratibhas for school and college students to ignite their interest in pursuing a career in basic science. Every year KSCSTE conducts a five-day science camp for the Pratibha Scholars in collaboration with reputed academic and research organizations in Kerala, namely Students Programme for Excellence in Experimental Design (SPEED). This year's SPEED program is named as SIGN IN (Science to Ignite Inspirations) and it is conducted at International School of Photonics (ISP), CUSAT from 14th to 18th February 2017. SIGN IN was a five day residential science camp for the KSCSTE Sastra

Travelling Lecturer programme

SPIE VISITING LECTURER PROGRAM

Prof. Chen Nanguang from National University of Singapore visited ISP on 26th February 2016 and gave the keynote address for the National Photonics Symposium and Annual Workshop (NPSAW) held from 26-28 february 2016. He visited ISP as a part of the SPIE visiting lecturer program and he also interacted with chapter members and the lecture was on the topic “Novel techniques for 4D imaging of biological samples in vivo”.

OSA VISITING LECTURER PROGRAM

Prof. Kishan dholakia, St. Andrews University, Scotland visited ISP as a part of the OSA visiting lecturer program. There were lectures and interaction sessions during his stay at ISP from 14-16 march 2016. His lectures were really informative and impressive speaking on the scale of his presentation skills. There were three illuminating lectures, each of them being interesting in its own ways as it titles: 1. Lights, camera, action: Optics in Healthcare, 2. Shaped beams and applications for biomedical imaging, 3. Let light move you: optical manipulation.

The visiting lecturer program is having great impact on the student chapters as well as student community by enabling us to be in contact with renowned scientists around the globe.

Glimpses of life @ ISP

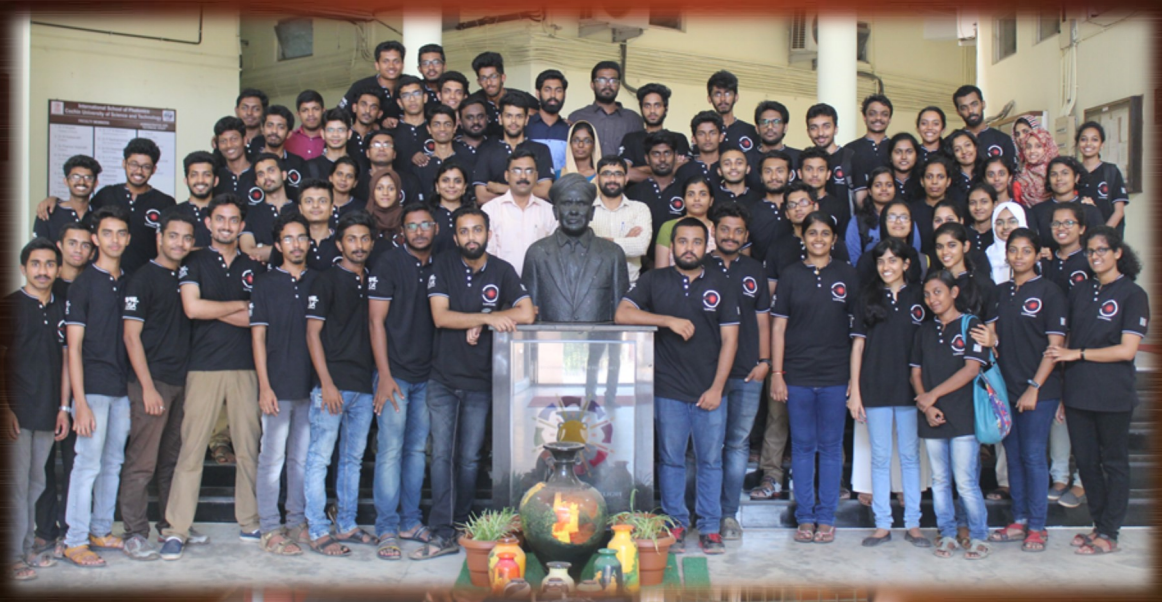
Onam Celebration

Christmas Celebration

Fresher's Day

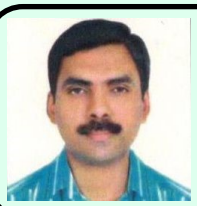
Sasthrayaan

Etch New 2017



Researchers day Out

ISP Faculties



Dr. A. Mujeeb

Director & Professor

Dr. M. Kailasnath

Professor

Dr. Pramod Gopinath

Professor

Dr. Saji K J

Assistant Professor

Dr. Manu Vysakh

Assistant Professor

Dr. Sheenu Thomas

Associate professor

Dr. Priya rose

Assistant Professor

Muhammed Rishad K P

Assistant Professor

Dr. V P N Nampoori

Emeritus Professor

Dr. C P Girijavallabhan

Emeritus Professor

Dr. P Radhakrishnan

Emeritus Professor

Dr. V M Nandakumaran

Emeritus Professor

Dr. Sreenivasan Nair

Adjunct faculty

Dr. Rajendran

Visiting Faculty

Dr. T.R. Ananthakrishnan

Visiting Faculty

Dr. Varadarajan

Visiting Professor

Ms. Anjitha Viswanath

Assistant Professor

(On Contract)

Mr. Siraj

Section Officer

CUSAT