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PHOTONICS NEWS

INTERNATIONAL SCHOOL OF PHOTONICS

The opening paragraph of Einstein's 1917 paper, "On the Quantum Theory of Radiation."

NATIONAL PHOTONICS SYMPOSIUM 2018

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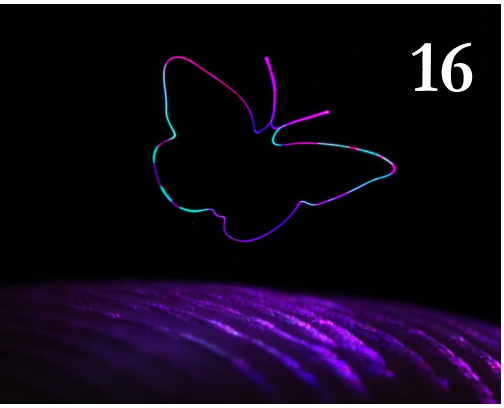
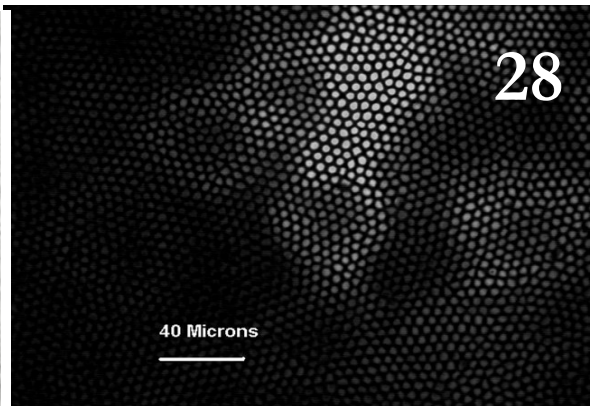
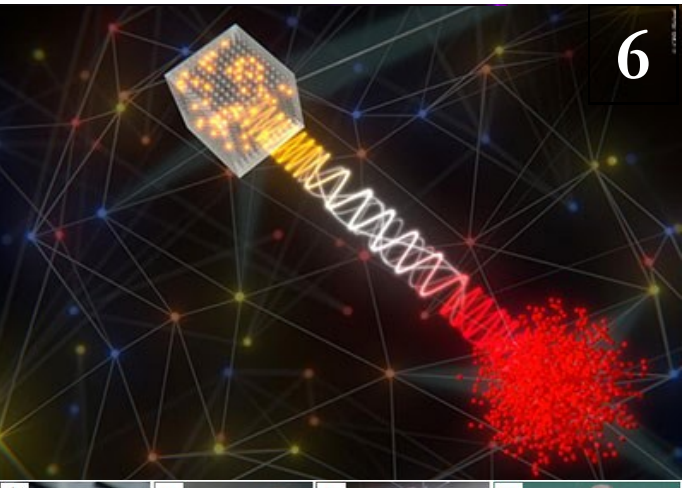
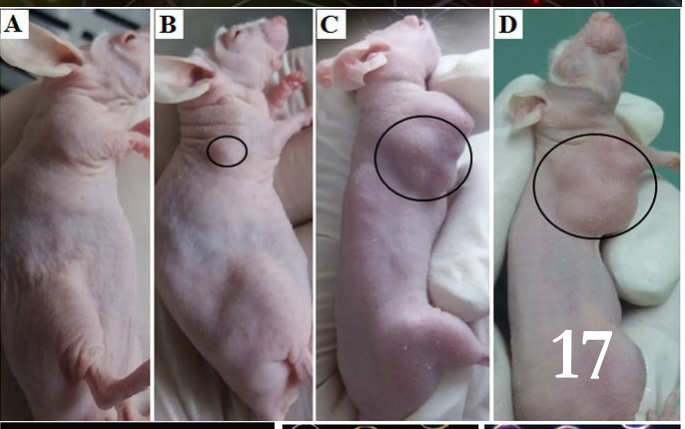
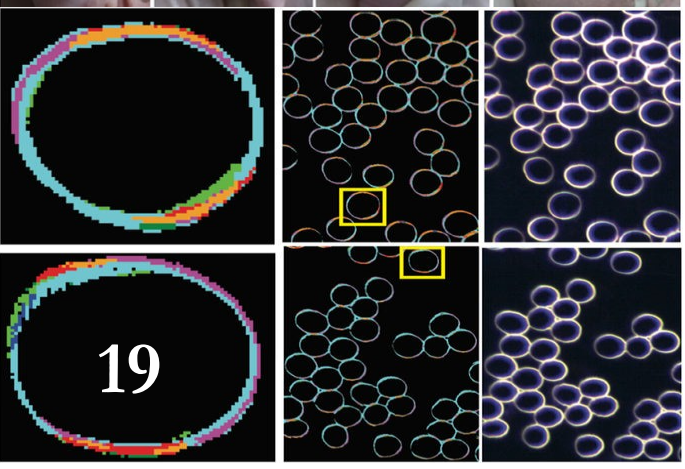








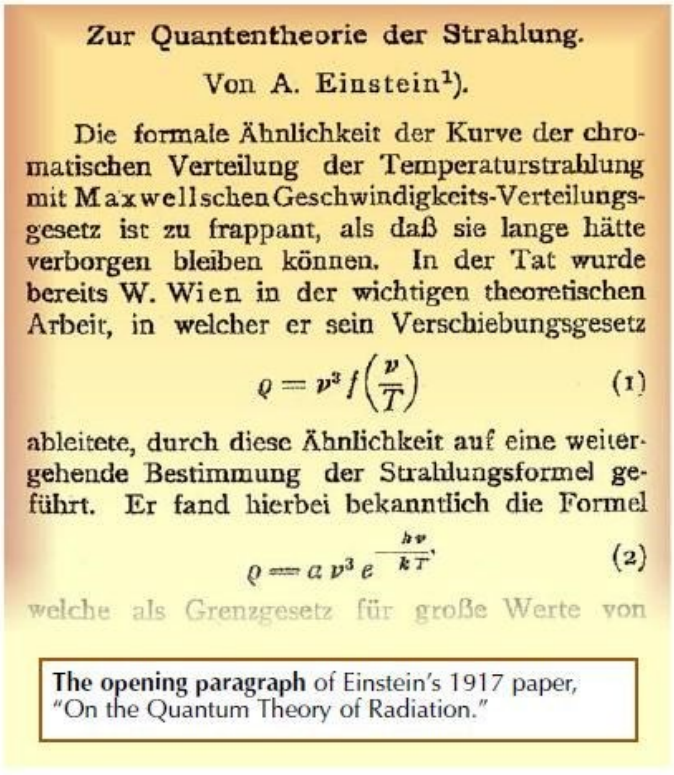


ABOUT THE COVER PAGE

One Hundred Years of Einstein's Quantum Theory of Radiation

The cover page of this edition of Photonics News and the selection of focal theme of National Photonics Symposium as Light – Matter Interaction is a tribute to Einstein whose insights unraveled secrets of Nature at macroscopic to microscopic scales. Even his criticisms and questionings of quantum mechanics have made it possible to lead towards discoveries and inventions like entangled states and spooky forces, experimental supports to quantum mechanics through violation of Bell's inequality in quantum optics, new mode of communication through entangled photons, and lately some works indicating the speed of spooky force as 10,000 times that of light and the discovery of gravitational waves. In a sense the discovery of gravitational waves is based on a strange form of light – matter interaction involving light waves and gravitational waves. Thomas Kuhn describes the progress of science through a series of revolutions, but revolutions do not happen every day.

One can think of the discoveries and inventions like fire, wheel, electric bulb, Planck's formulation of the theory of black body radiation, Einstein's quantum theory of radiation and concept of photons, IC chips, lasers, chaos theory belong to this class of revolutions resulting into the progress of Physics and its impact on other fields of human thought. Among this list, photon concept and quantum theory of radiation take a separate position since their creator was criticized by many physicists to that extent that Einstein himself was once on the verge of abandoning the revolutionary concept of photon. The insight and intuition of Einstein was fathomless that after one hundred years of its inception, quantum theo-



Zur Quantentheorie der Strahlung.

Von A. Einstein[1]).

Die formale Ähnlichkeit der Kurve der chromatischen Verteilung der Temperaturstrahlung mit Maxwellschen Geschwindigkeits-Verteilungsgesetz ist zu frappant, als daß sie lange hätte verborgen bleiben können. In der Tat wurde bereits W. Wien in der wichtigen theoretischen Arbeit, in welcher er sein Verschiebungsgesetz

$$\varrho = \nu^3 f\left(\frac{\nu}{T}\right) \qquad (1)$$

ableitete, durch diese Ähnlichkeit auf eine weitergehende Bestimmung der Strahlungsformel geführt. Er fand hierbei bekanntlich die Formel

$$\varrho = a\,\nu^3\, e^{-\frac{h\nu}{kT}}, \qquad (2)$$

welche als Grenzgesetz für große Werte von

The opening paragraph of Einstein's 1917 paper, "On the Quantum Theory of Radiation."

Dr. V P N Nampoori
Emeritus Professor
ISP, CUSAT

DIRECTOR'S MESSAGE

Prof. A Mujeeb

Director

Tremendous progress made in the last couple of decades in almost all fields of technology helped to improve the social status and well-being of all. The innovations made the products faster, cheaper, reliable and more versatile. This is very true in the case of Photonics, which gives the state of the art technology wherever light, interacts with matter. Photonics is now the platform and also the interface between photon and electron for motivating highly influenced research and technologies and has become a significant enabler of this revolution. Thus the uses of light in the related disciplines hold out possibilities for hitherto unimaginable application in all aspects of human endeavours on a safer side compared to the other existing technologies especially in medical field. As years pass, the area of specialisation in Photonics is poised for a big growth and capacity development becomes more crucial. We need more and more training and sharing for propagating the innovations among professionals, academia and industry. We must have human resource development in the field to transit the ideas as the younger generation will take the path lead by the existing giants.

I am extremely proud and happy that the International School of Photonics is moving in the right direction and excelled in excellence by adding new facilities, conducting several programs and receiving the best outputs in research and development. This will gather further acceleration with the new facilities such as CCD, Oscilloscope, RF sputtering units etc.

I am expressing my profound happiness to the whole hearted support extended by my colleagues and students for materialising such progress in the school. I am indebted to the honourable Vice Chancellor and other all officers for their help, support and directions.

We all know, as a discipline that is advancing at lightning speed it is essential for its protagonists to exchange ideas to sustain and nurture the progress. It is in this context that we have this National Photonics Symposium again with new thoughts, new mind-set, and new hope for the future.

I am sure that this NPS 18 is scientifically rewarding and a good platform for all the stakeholders in the field.

I congratulate the editorial board and all the contributors for bringing out such resourceful news. Hope this publication also show case our strength and achieves, especially in the research field.

With love and prayers

A MUJEEB

Awards and Achievements

In the Academic Year 2017–2018

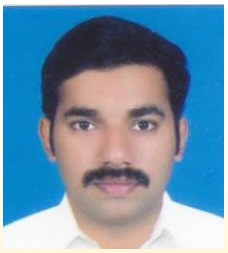
Academic Toppers

Mary Ida Melody
[M.Sc. 2012-2017]

C V Raman Award
[Best Project]

&

Prof. Leggett Award
[Highest CGPA]



Surjith S
[M.Tech. 2015-2017]

Satish John Memorial Award
[Best Project]

&

Photonics Society of India Award
[Highest CGPA]

Anand V R
Research Scholar

Best poster Award in DAE BRNS National Laser Symposium - 26 at BARC, MUMBAI

Recent Placements

Divya N Nair, M.Tech. [2015-2017]
QWave Soft Systems, Kochi

Chinthulal V, M.Tech. [2015-2017]
QWave Soft Systems, Kochi

Awards and Achievements

Recent Placements

Ostwald Franklin Peter, M.Sc. [2011-2016]
Optical engineer, Varroc Lighting, Pune

Muhammed Fazil C P, M.Sc. [2011-2016]
Project manager, Qatar metro

Rahul Krishnan, M.Sc. [2011-2016]
RF Engineer, RS Spectra

R Eruthuparna

P.Gautham

Harsha Surendran

M.Sc. [2014-2019]

Best Mini Project Award [Sixth semester, M.Sc.]

Sisira S
M.Sc. [2017-2021]

Nalanda Endowment Award
[Topper in first Semester]

Sony U
Research Scholar

Best Researcher Award at ISP

Musfir P N
Research Scholar

Best oral Presentation Award in National Seminar on Crystal Growth and Applications at Sacred Heart College, Tirupattur, Tamil Nadu

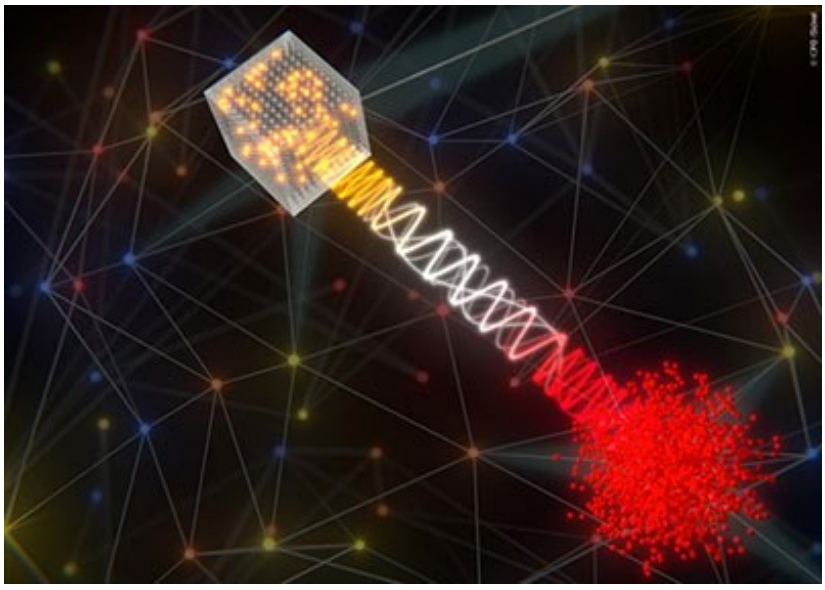
Articles

Quantum Computing Takes New Strides

The future computers

The concept of quantum computers has been around for quite some time. In these kinds of computers quantum bits or qbits, instead of binary bits are utilized for computing purposes. The practical realization of such a computer system is still some time away. However there is a renewed interest in the subject as IBM has announced a 50 qbits 'quantum processor that works'.

Quantum computers can do things which classical computers cannot do as the former can have virtually unlimited computing power. However these are still not available commercially even though intense research has been going on in various laboratories of industry leaders.



Qbit connections- Photons link atoms and ions in the crystals (courtesy: Physics World)

Larger the number of interconnected qbits, greater will be the computing power which increases exponentially with the number of qbits. IBM had announced earlier a 20 qbits processor that operates at 20 milliKelvin. This is available to IBM clients through its cloud computing facility.

The stability of qbits is determined by what is known as 'coherence time'. Even at temperatures close to absolute zero, the quantum states will be washed out by de-coherence effect. Larger coherence time will provide better stability to the quantum states involved. IBM's present system has a coherence time of 90 microseconds.

The industry giant Google is trying to build quantum computers that can solve problems which are intractable for any classical machine. 'Quantum supremacy' is the condition achieved when these quantum computers overtake the computing power of classical machines. It is concluded that one needs anything between 50 to 100 interconnected quantum bits to reach quantum supremacy. Preserving this many number of qbits in coherent state is a challenging task. In the meantime Nicolas Maring and colleagues at the Institute of Photonics Sciences and the Barcelona Institute of Science & Technology have succeeded in transferring qbits between an atomic gas system and a doped crystal.

Of course, photons have to be used to transfer information between such systems. Doped crystals or gas systems can have stable quantum states and these act as nodes for qbits. If the nodes are of the same kind, it is fairly easy to transfer qbits, as one emits a qbit as encoded photon and that is absorbed directly by the other node. However in a practical quantum system it is necessary to transfer information between different types of nodes. The Spanish scientists have succeeded in building a 'hybrid' quantum network by converting the photon emitted by the gaseous system to longer wavelengths to make them suitable for absorption by the doped crystals. They use optical fiber to carry the photons from one node to another. Thus qbit transfer between different kinds of nodes is made possible by using this technique. The above scientists think that by adopting this technique they can even create a 'quantum internet'. The research is described in November 23,2017 issue of Nature.

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Image processing in fiber bundle based systems: A Primer

The fiber optic technology was initiated in the context of development of flexible endoscope for in-vivo imaging. Interfacing the in-vivo region of interest with detection devices is accomplished by coherent fiber bundle, generally named as image fiber. In an image fiber, tens of thousands of fibers are combined in a bundle with active area of the order of about 1 mm^2. Each fiber transfers a spot of light from the input end to the output side. As a result, these can be used for delivering as well as collecting light from inaccessible areas like colon. With appropriate selection of optical devices and detection schemes coupled with the image fiber, one can study spectroscopic as well as morphological details of the target samples. Use of image fiber as a probe in microscopy application generally requires microscope objective for sample imaging. This can be miniaturized by using a grin lens at the distal end of the image fiber (Fig. 1).

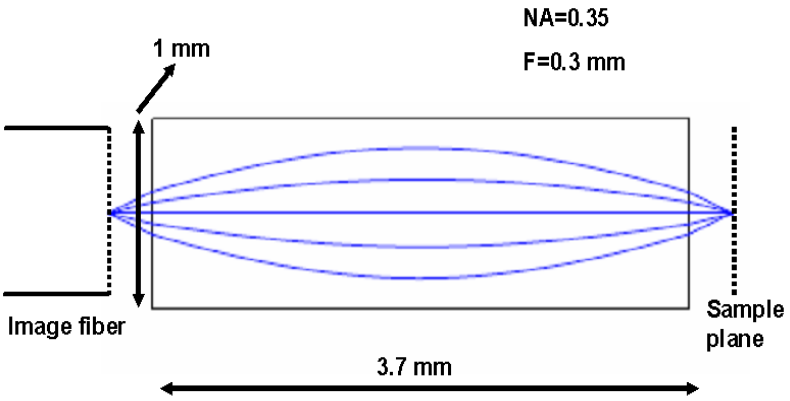


Fig.2 Light propagation in the grin lens

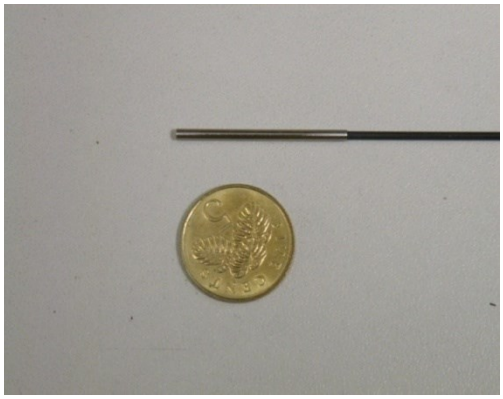
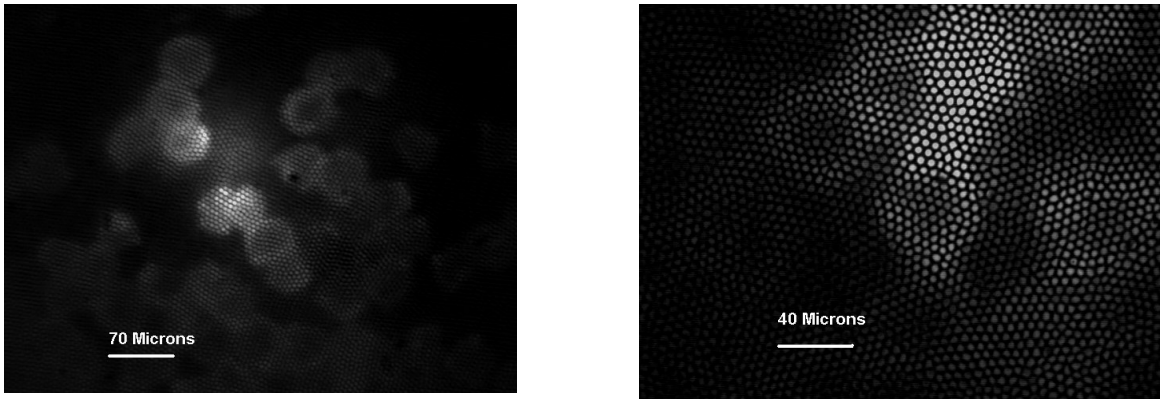


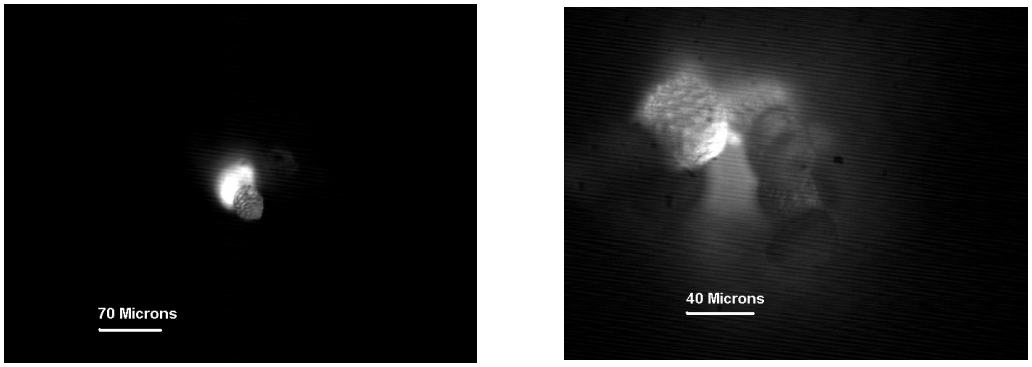
Fig.1 Image fiber bundle with grin lens



(a) (b)

Fig.3 Image of the sample imaged by image fiber probe at various MO magnifications a) Magnification 10X b) Magnification 20X

To understand the effect of image fiber on the degradation in the image resolution, another experiment was carried out to image the same sample without the image fiber. Results obtained at various MO magnifications (10X, 20X) are given in Fig. 4. From the figures, we can see the morphology of the sample very clearly. Comparing these images with those captured through the image fiber probe, it can be seen that the resolution gets degraded on employing an image fiber bundle. It is worth pointing out that image fiber probe can be used effectively for imaging applications that do not demand lateral resolution in the submicron range. For example, these probes can be used for tissue imaging whose dimensions are around 10 micron.



(a) (b)

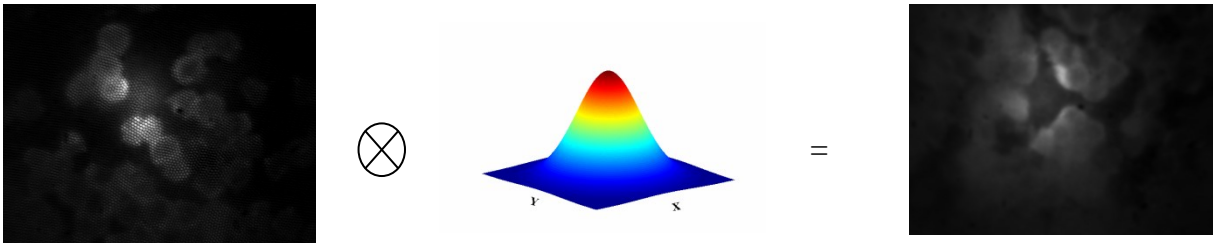
Fig.4 Image of the sample at various MO magnifications a) Magnification 10X b) Magnification 20X

The grin lens collects the diverging beam from the image fiber and focuses it to the sample as shown in Fig. 2. The signal originating from the sample travels back through the grin lens and gets focused on the image fiber plane. Fig. 3 shows the fluorescence images of redwop powder obtained at various MO magnifications (10X, 20X). It is clear from the figures that the quality of the image is degraded by the cladding around each core. The discontinuity in the image due to the hexagonal pattern of the fiber is more evident in higher magnifications. It can be understood from the figures that the cladding also reduces the resolution of the image transmitted.

Imaging with image fiber probes results in honeycomb fiber structure in the image. The structure is more prominent at higher magnification. Several techniques can be used to remove the honeycomb structure from an image obtained using an image fiber probe. One example is Gaussian filtering. A Gaussian filter modifies the image by convolving it pixel by pixel with a Gaussian function,

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\left(\frac{x^2+y^2}{2\sigma^2}\right)}$$

As a result, the original pixel values are replaced by a weighted average of the neighboring pixel values. The original pixel receives the maximum weighted value and the neighboring pixels receive weighted values which decrease with distance from the central pixel. The honeycomb structure in the image due to the image fiber bundle is more or less periodic. As a result, such an averaging procedure will remove the periodic structure in the image. This process is schematically represented in Fig. 5. Image acquired with the probe at 10X magnification was convolved with the filter to get an image without the hexagonal fiber structures of the individual fibers.



(a) (b)

Fig. 5 Schematic representation of the action of Gaussian filter (a) Convolution operation on the image captured by image fiber probe b) Image without honeycomb structure

We can also employ an alternate technique in Fourier domain.

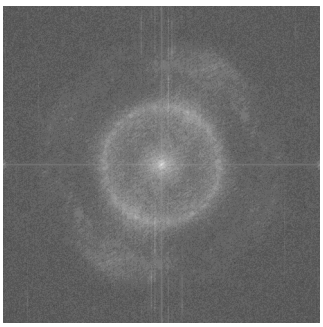


Fig.6 Fourier Spectrum of the image obtained using fiber bundle

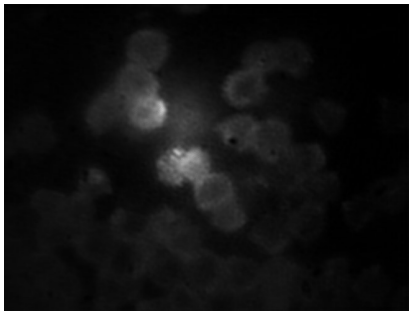


Fig.7 Effect of bandreject filter

Since the individual fibers are more or less spaced at equal distances in the fiber bundle, they create a periodic pattern in the image transmitted through the probe. As a result, the Fourier transform of the image will clearly show the structure of the fibers.

Fig. 6 shows the Fourier spectrum corresponding to such an image. As seen in the Fourier spectrum, a ring structure is visible at a high frequency region. This corresponds to the spectral information related to the structure of the image fiber.

Removing this ring structure using a band reject filter and performing the inverse transform will result in an image without the prominence of the honeycomb structure present in the image fiber. Fig. 7 shows the filtered image. Even though the fine morphological details of the sample which were acquired without the image fiber could not be resolved in the processed image after performing either Gaussian filtering or filtering the spectral component of the honeycomb structure, the filtered images provide visualization of the sample structure without the fiber honeycomb details. One of the research areas is to develop filtering techniques to remove the honeycomb structure from the images without sacrificing the image resolution.

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The Luminescent Soot

The future of White Light Emission

In everyday life, we come across soot of various origin. Some are more harmful and some others less. Some of them are toxic and some others non-toxic. One factor, that is common in all forms, is the presence of various allotropes of carbon. If we succeed in the effective utilization of these futile materials, that will be good to mankind. Carbon nanoparticles have gained significant attention in the 21st century being a promising material due to its good electrical/thermal conductivity and enhanced chemical/biocompatibility. It has a wide range of applications in optoelectronics, biological studies, chemical sensing, etc. The important issues with the production of carbon nanoparticles are its cost and quality. There are several chemical and physical methods of synthesizing carbon nanoparticles. Some of them include laser irradiation and exfoliation, sonication, thermal carbonization, etc. One of the important factors in controlling the morphology and the yield of the carbon nanoparticles is the raw materials used in the synthesis. Due to increasing demand for carbon-based nanomaterials in various fields, there is a need to produce carbon nanoparticles of good quality from various carbon sources. In this article, the blue light emission by diesel soot and camphor soot are discussed.

Search for safe, long lasting, and high energy efficient alternatives to traditional incandescent bulbs have been the focus of research for several years. The existing incandescent and fluorescent lamps have been overpowered by the invention of the Light Emitting Diodes (LEDs) due to their high energy conversion efficiency and life span along with the absence of the toxic mercury. Among the LEDs discovered yet, the scientific world demands that the most efficient one will be the white LEDs (WLEDs). The design of WLED is a very challenging area of research since the pure materials show their emission only in a very small range in the visible spectrum. The commonly used methods for producing white LEDs are either a blue LED is created and then a phosphor coating is given or a combination of red, green and blue LEDs are required. In both the methods the blue emitting materials play a vital role in the production of WLEDs. Though organic semiconductor materials, carbon dots, etc. are introduced for producing blue light emissions, the user-friendly fluorescent blue LED materials should exhibit high thermal stability, efficiency and long lifetime and also emit deep blue light. The materials satisfying these conditions are difficult and costlier to fabricate.

There exist a large number of exceptionally stable and efficient red and green emitting materials, but the blue light emitting low-cost materials with good performances are still very rare. In this article low-cost synthesis of the blue light emitter from soot is discussed. The high temperature and pressure inside the combustion chamber of ICEs produce soot particles by the incomplete combustion of hydrocarbons leading to the formation of various allotropes of carbon.

Camphor soot is another potential material for the synthesis of a blue light emitter. Camphor is an easily available hydrocarbon source which is natural in origin from the tree *Cinnamomum camphora*. It can be effectively used for the synthesis of various allotropes of carbon with exceptional properties. The soot incinerated from the incomplete combustion of hydrocarbons present in the camphor leads to the formation of non-toxic carbon rich camphoric soot.The color is a sensation resulting from the spectral distribution of light, which is detected by the three color sensors present in the eye. This being the main idea we can express the color or chromaticity space in terms of *x*, *y* and *z* coordinates. This chromaticity space is termed as CIE 1931 RGB color space and CIE 1931 XYZ color space which is created by the International Commission on Illumination (CIE) in 1931. According to the standard Red Green Blue (sRGB),which is the commonly used RGB color space, the CIE (x, y) coordinates for red, green, blue, and white emission are (0.340,0.330), (0.300,0.600), (0.150,0.060) and (0.312, 0.329) respectively. The attempts are going on to find suitable materials with CIE coordinates very close to these values owing to their applications in solid-state lighting and optoelectronics.The role of quantum yield measurement of a material is significant in the better understanding of its luminescent and fluorescent properties and also for exploring its application as efficient light sources. It gives the fraction of the photons emitted to that absorbed which is usually measured using integrating sphere method.

The effective use of the hazardous pollutant diesel soot from the internal combustion engines (ICEs) of vehicles is very important in the present day scenario due to the increasing rate of environmental pollution in the world as these engines are an inevitable component in everyone's day to day life.

The luminescent properties of the material are explored by the nondestructive analytical technique- Photoluminescent (PL) spectroscopy. The PL spectra of the purified soot samples are recorded in the range 400- 800 nm for excitation wavelengths (λ_{exc}) of 325 nm, 350 nm, and 390 nm. The PL spectra show emission peaks at 459nm, 465 nm, and 466 nm for the excitation wavelengths of 325 nm, 350 nm, and 390 nm respectively. The emission peak exhibits a shift to the longer wavelength regions with the increase in the excitation wavelength. The temperature dependence on the PL spectra of the camphor soot are studied by annealing the sample at 27^0C, 200^0C, and 400^0C and are recorded in the range 400- 800 nm for the excitation wavelengths (λ_{exc}) of 350 nm, that show peaks at 426 nm, (465,575 nm) and (465,573 nm) respectively. The excitation wavelength dependent emission mechanism is attributed to the presence of non-uniform carbon dots in the sample. From the literature it is clear that diesel soot composes a mixture of various allotropes of carbon such as amorphous carbon, carbon nanotubes, dots, graphene and graphene-related materials depending on the percentage of sp^3, sp^2 and sp^1 sites present in each forms, resulting in wide range of properties exhibited by them. The optical transitions taking place between the σ and π orbitals contribute to the emission observed in the PL spectrum. Thus,it is evident that the major peaks for all excitation are centered at 460 nm which falls in the bright blue region in the visible spectrum.

A more clear indication of blue light emission is attained by exciting the sample by a UV laser at 325 nm. This physical observation is made possible by taking the purified sample in a quartz cuvette and subjecting it to UV irradiation. The perception of human eye to the emission from a light source, giving out radiations of different wavelength and intensity can be expressed with the help of chromaticity diagram or CIE plot. The coordinates in the CIE plot represents the color perception. From the CIE plot of the sample for different excitation wavelengths it can be seen that the sample exhibits luminosity in the blue region The power spectrum shows a maximum emission in the blue region. The CIE and power spectrum of the camphor soot annealed at different temperatures can be used for LED applications, The sample under study is found to give a quantum yield of about 46.15% for an excitation at 350 nm.

The particulate matter from ICEs and camphor soot containing rich carbon content exhibits luminance in the bright blue region enabling its use

as a blue light emitting material in many electronic and optoelectronic applications, mainly in the production of white LEDs. The purified soot sample contains nanosized particles which shows blue emissions and is confirmed from the PL spectra, power spectra, CIE plot and physically evidenced by the UV excitation. The work is highly significant in the context of increasing pollution in the atmosphere due to soot particles and the ongoing search for low-cost blue emitters for lighting applications. Perfect blue emitter can be obtained from the soot on the exact estimation of percentile composition of allo-

For more details

1. Swapna M S, Saritha Devi H V, Sankararaman S (2018) Camphor soot: A Tunable Light Emitter. Applied Physics A 124:50;doi: 10.1007/s00339-017-1445-9
2. Swapna M S, Sankararaman S (2018) Blue Light Emitting Diesel Soot For Photonic Applications.*Mater. Res. Express,* https://doi.org/10.1088/2053-1591/aaa656

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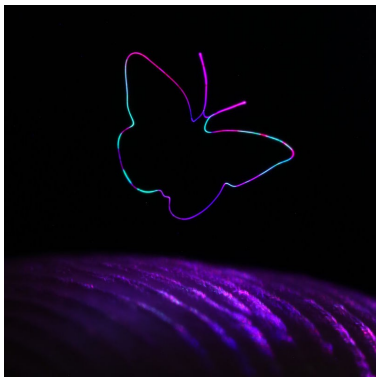
In the News

Physicists create Star Wars-style 3D projections

Laser and particle system produces three-dimensional moving images that appear to float in thin air



Recreated 3D Image

Recreating the 3D images closer to that of Princess Leia in 1977 film Star Wars, employing technique called **A photophoretic-trap volumetric display. Figure shows the floating butterfly created with a single particle using a techniques known as volumetric display.**

The technique, described in *Nature* on 25 January18, works more like a high-speed Etch a Sketch: it uses forces conveyed by a set of near-invisible laser beams to trap a single particle — of a plant fibre called cellulose — and heat it unevenly. That allows researchers to push and pull the cellulose around. A second set of lasers projects visible light — red, green and blue — onto the particle, illuminating it as it moves through space. Humans cannot discern images at rates faster than around 10 per second, so if the particle is moved fast enough, its trajectory appears as a solid line — like a sparkler moving in the dark. And if the image changes quickly enough, it seems to move. The display can be overlaid on real objects and viewers can walk around its space This platform, named the Optical Trap Display, is capable of producing image geometries that are currently unobtainable with holographic and light-field technologies, such as long-throw projections, tall sand tables and 'wrap-around' displays.

Einstein's spooky action acts at 10,000 times the speed of light

A spooky effect that could in theory connect particles at the opposite ends of the universe has been measured and found to exert its unsettling influence more than 10,000 times faster than the speed of light. The enlightening study has been carried out by the team of Prof Nocolas Gisin, University of Geneva.

The effect, once described by Albert Einstein as 'spooky action at a distance' underpins quantum teleportation, a Star Trek like ability, and the next generation of encryption methods and superfast quantum computers too. Now, by making measurements in two Swiss villages separated by 11 miles, Daniel Salart, a doctoral student working with the team of Prof Nocolas Gisin at the University of Geneva, has run detailed measurements and concluded that if this spooky action really exists, it must act faster than light. The new work lays down a lower speed limit of 10,000 times the speed of light. This study in the journal Nature suggests that a physical signaling mechanism that connects the villages is deeply implausible, because of the well known limit of the speed of light To look for this spooky force, Mr Salart entangled their photon pairs using a source in Geneva, then passed them through fibre-optical cables of exactly equal length to the villages of Jussy and Satigny, which lie respectively east and west of Lake Geneva. Here, the photons' entanglement was checked by an identical pair of instruments to reveal consistent entanglement of their photons, and the effects of the Earth's rotation taken into account, so they conclude that any signal passing between the entangled photons is, if not instantaneous, travelling at least ten thousand times faster than light.

Physicists are planning to build lasers so powerful they could rip apart empty space

With the demand for highly powerful laser pulses increasing at enormous pace, the Chinese group of researchers headed by Ruxin Li are leading the way ahead by fabricating ultra powerful yet table top sized lasers with an unprecedented petawatts power.

In Shanghai, China, physicist Ruxin Li and colleagues are breaking records with the most powerful pulses of light the world has ever seen. At the heart of their laser, called the Shanghai Superintense Ultrafast Laser Facility (SULF), is a single cylinder of titanium-doped sapphire about the width of a Frisbee. After kindling light in the crystal and shunting it through a system of lenses and mirrors, the SULF distills it into pulses of mind-boggling power. In 2016, it achieved an unprecedented 5.3 million billion watts, or petawatts (PW). Although the pulses are extraordinarily powerful, they are also infinitesimally brief, lasting less than a trillionth of a second. The researchers are now upgrading their laser and hope to beat their own record by the end of 2018 with a 10-PW shot, which would pack more than 1000 times the power of all the world's electrical grids combined. The laser has sufficient power to rupture the vacuum. Studies will provide in future some new physics and new technology .

Taming the diesel soot as white light emitting source to fabricate WLEDs

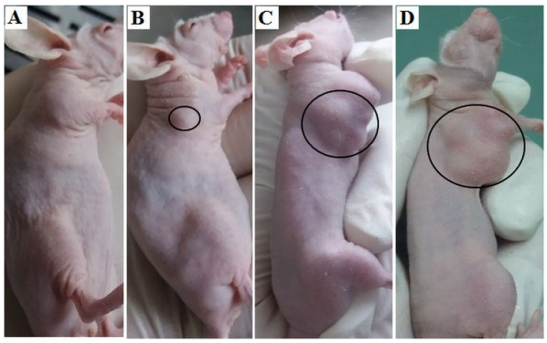
As the design of WLED is a very challenging field of research, the innovative idea of low-cost synthesis of the blue light emitter from diesel soot, as a helping hand in the synthesis of WLED is promising and impactful.

The Photonics Group of Dr Sankararaman (Dept of Optoelectronics, Kerala University, India) gave a value added solutions to the automobile exhaust by extracting from the exhaust a mixture of carbon dots and grapheme which give white light fluorescence emission under UV excitation. This discovery has dual importance namely low budget synthesis of white light emitting phosphor free photonic material and reducing atmospheric pollution due to automobile exhausts. At present the fluorescence quantum yield is about 47 % which, the group feels, can be improved by modifying the extraction procedure . A future design of automobile engines can be employed for transport vehicles as well as for the supply of photonic materials.

Spectrum of spontaneous photon emission as a promising biophysical indicator for breast cancer research

The striking difference between the spectral distribution of SPE from the body surface of tumor mice and that of healthy controls can work as an indicator of breast cancer growth.

In this study, it was investigated the spectral characteristics of Spontaneous Photon Emission (SPE) from the body surface of a human breast cancer-bearing nude mice model during the overall growth process of breast cancers. By comparing and analyzing the data, we found that there was a striking difference between tumor mice and healthy controls in the spectral distribution of SPE from the body surface of lesion site, even when the morphological changes at the lesion site were not obvious. In addition, the difference in spectrum was related with different growth states of tumors. There was a positive correlation between the spectral and the logarithm of the tumor volume for both the lesion site and the normal site of the tumor mice. The results suggested SPE spectrum was sensitive to changes in the tumor status.



Different growth stages of a mouse whose right axillary was injected with breast cancer cells. DOI:10.1038/s41598-017-13516-8

Coherent control of an opsin in living brain tissue

Chirped ultrashort near-infrared pulses have been used to modulate the functioning of retinal-based opsins. A novel mechanism of light pulse shaping has been used to control the photo-activated cell function.

Retinal-based opsins are light-sensitive proteins. The photoisomerization reaction of these proteins has been studied outside cellular environments using ultrashort tailored light pulses. However, how living cell functions can be modulated via opsins by modifying fundamental nonlinear optical properties of light interacting with the retinal chromophore has remained largely unexplored. We report the use of chirped ultrashort near-infrared pulses to modulate light-evoked ionic current from Channelrhodopsin-2 (ChR2) in brain tissue, and consequently the firing pattern of neurons, by manipulating the phase of the spectral components of the light. These results confirm that quantum coherence of the retinal-based protein system, even in a living neuron, can influence its current output, and open up the possibilities of using designer-tailored pulses for controlling molecular dynamics of opsins in living tissue to selectively enhance or suppress neuronal function for adaptive feedback-loop applications in the future.

Increased light penetration due to ultrasound-induced air bubbles in optical scattering media

An ultrasound-assisted light penetration increase has been proposed, which can be of great use in the field of optical imaging and therapy.

Light is an attractive tool for high spatial- and contrast-resolution imaging, highly sensitive molecular imaging, and target-selective therapy, and it does not exhibit the risks associated with ionizing radiation. The main limitation of using light in clinical applications is its superficial imaging and therapeutic depth caused by high optical scattering in biological media. A group of researchers demonstrate that the scattering and thus defocusing of the incident light can be alleviated when simultaneously delivered ultrasound generates air bubbles in the pathway of the incident light, thus increasing the light penetration. The bubbles are temporally induced by ultrasound with an intensity that is sufficiently low to avoid tissue damage and act as a Mie scattering medium in which light is scattered predominantly in the forward direction. The change in the optical scattering property caused by the ultrasound is undone after cessation of the sonification. From the results, it is expected that this proposed method will open a new route for overcoming the limitations of current optical imaging and therapeutic techniques.

Generation of bio-inspired structural colors via two-photon polymerization

A simple method for the artificial generation of structural purple and green colours is discussed, by varying the thickness inside the microstructure's periodicity.

Colors of crystals, pigments, metals, salt solutions and bioluminescence occur in nature due to the optical properties of electrons in atoms and molecules. However, colors can also result from interference effects on nanostructures. In contrast to artificial coloration, which are caused by well-defined regular structures, the structural colors of living organisms are often more intense and almost angle independent. In a new report authors describe the successful manufacturing of a lamellar nanostructure that mimics the ridge shape of the Morpho butterfly using a 3d-direct laser writing technique. The viewing angle dependency of the color was analyzed via a spectrometer and the structure was visualized using a scanning electron microscope. The generated nano- and micro-structures and their optical properties were comparable to those observed in the Morpho butterfly.

Flexible polarimetric probe for 3 × 3 Mueller matrix measurements of biological tissue

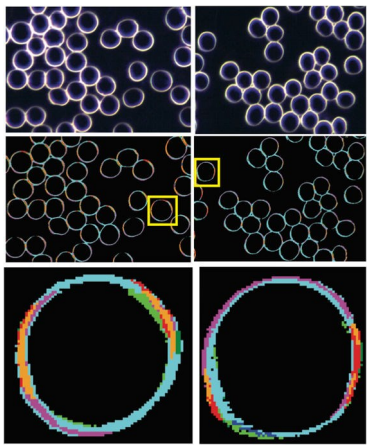
A flexible, 6-fibre probe capable of accurate 3 × 3 linear Mueller matrix measurement of polarisation components and of birefringent biological tissues is discussed.

Polarimetry is a noninvasive method that uses polarised light to assess biophysical characteristics of tissues. A series of incident polarisation states illuminates a biological sample, and analysis of sample-altered polarisation states enables polarimetric tissue assessment. The resultant information can, for example, help quantitatively differentiate healthy from pathologic tissue. However, most bio-polarimetric assessments are performed using free-space optics with bulky optical components. Extension to flexible fibre-based systems is clinically desirable, but is challenging due to polarization altering properties of optical fibres. Authors propose a flexible fibre-based polarimetric solution, and describe its design, fabrication, calibration, and initial feasibility demonstration in *ex vivo* tissue. The design is based on a flexible fibre bundle of six multimode optical fibres, each terminated with a distal polariser that ensures pre-determined output polarisation states. The resultant probe enables linear 3 × 3 Mueller matrix characterization of distal tissue. Potential *in vivo* Mueller matrix polarimetric tissue examinations in various directly-inaccessible body cavities are envisioned.

High predictive values of RBC membrane-based diagnostics by biophotonics in an integrated approach for Autism Spectrum Disorders

The approach described suggests biophotonic methodologies as part of a multidisciplinary platform combined with molecular diagnostics to give a more comprehensive description of cell compartments such as RBC membranes.

Membranes attract attention in medicine, concerning lipidome composition and fatty acid correlation with neurological diseases. Hyperspectral dark field microscopy (HDFM), a biophotonic imaging using reflectance spectra, provides accurate characterization of healthy adult RBC identifying a library of 8 spectral end members. Authors report hyperspectral RBC imaging in children affected by Autism Spectrum Disorder (ASD) (n = 21) compared to healthy age-matched subjects (n = 20), investigating if statistically significant differences in their HDFM spectra exist, that can comprehensively map a membrane impairment involved in disease. A significant difference concerning one end member (spectrum 4) was found (P value = 0.0021). A thorough statistical treatment evidenced: i) diagnostic performance by the receiving operators curve (ROC) analysis, with cut-offs and very high predictive values (P value = 0.0008) for identifying disease; ii) significant correlations with clinical parameters and with the RBC membrane deficit of the omega-3 docosahexaenoic acid (DHA) in ASD patients; iii) by principal component analysis, very high affinity values to the factor that combines behavioural parameters. These results foresee the use of biophotonic methodologies in ASD diagnostic panels combining with molecular elements for a correct neuronal growth.



RBCs optical images and the corresponding hyperspectral image for healthy (left panels) and ASD (right panels) children.
[DOI:10.1038/s41598-017-10361-7]

New Doctorates From ISP

Hall of Fame

Ms. Bini P Pathrose

Investigations on Optical Characteristics of Certain Dyes With Silver Nanoparticles for photonic applications

Under the Supervision of Prof. A Mujeeb

Metal nanoparticles that exhibit rich plasmonic resonance properties due to collective oscillations of electrons in the visible range have been extensively used to tailor the properties of organic molecules. Manipulation of the characteristics of dyes using metallic nanoparticles for enhanced properties have attracted continuous scientific interest because of their widespread applications in the areas of photonics and optoelectronics. These dyes can be of organic or inorganic in nature, synthesized either from natural sources or by artificial means. Among the metallic nanoscale particles, silver nanoparticles have been continuously focused by the research community for its unique size dependent optical and electronic properties which can be used for enhancing the properties of dyes. The thesis deals with the linear and nonlinear characterization of synthetic dyes Basic Fuchsin and Neutral Red in the presence of femtosecond laser ablated silver nanoparticles and its possible use in various photonic applications. Two photon induced emission studies were also conducted on the dyes Rhodamine 6G and Coumarin 480.

Mr. Linslal C L

Investigations on dye doped polymer optical fibers for the development of efficient microlasers

Under the Supervision of Prof. M. Kailasnath

Whispering gallery microcavities can support resonant modes called whispering gallery modes (WGMs) and they produce size dependent resonant frequency spectrum. WGM resonators confine optical fields into an interior region close to the surface of the resonator by resonant recirculation due to the total internal reflection at the boundary. Microresonators having diameters from a few tens to several hundreds of micrometers can have a very large free spectral range of several nanometers. Whispering gallery microcavities have been widely used in sensing applications, add–drop filters, narrowband filtering etc.

In addition to these applications, WGM microcavities incorporated with suitable active materials are important to make efficient, compact, very low threshold and narrow linewidth microlasers due to their small size and very high Quality factor. Being small in size, an optical fiber can be considered as a microcylinder having infinite length which can support WGMs. Exploiting the cylindrical structure of POF, microlasers can be realized from organic dye doped POFs. The dye acts as the active material which provides the gain and the cylindrical structure of the POF acts as the whispering gallery optical cavity which provides the resonant modes. WGM microlasing emission was observed from the surface of the step-index and hollow fibers under optical pumping. The whispering gallery microlasing modes were characterized by the polarization, angular and radial mode numbers. The dependence of the WGM microlasing emission on the pump pulse energy and the diameter of the fiber were also studied. It was observed that the WGM microlasing modes are confined and propagated through the graded-index fiber and are emitted from the ends of the fiber. We have demonstrated strongly modulated microlaser emission from the ends of a microring embedded hollow polymer fiber under optical pumping. Nearly single mode lasing was obtained from this polymer fiber system. Efficient microlasing could be demonstrated even at a propagation length of 1.5m. The microring embedded hollow polymer fibers also exhibit strong mode selection, good laser emission characteristics and highly sharp lasing modes.

Stress/strain tuning of whispering gallery microlasing modes of RhB doped POFs (both step-index and hollow) were investigated. It was observed that the whispering gallery microlasing modes of the polymer fibers were shifted linearly towards shorter wavelength side when a tensile strain is applied to one end of the fiber. It was also found that the tuning of the microlasing modes of the hollow fiber is reversible. The possibilities of amplification of the whispering gallery microlasing modes of polymer fibers have been studied. The microlasing modes generated from one polymer fiber were coupled to another polymer fiber leading to their amplification while propagating through the second (amplifying) fiber. A maximum gain of ~25 dB was observed under stripe optical pumping scheme.

Mr. Jaison Peter

Investigations on dye-doped PMMA based optical waveguides for photonics applications

Under the Supervision of Prof. M. Kailasnath

The main aim of this dissertation is to investigate different types of PMMA based dye-doped optical waveguides for photonic applications. The dissertation examines Amplified Spontaneous Emission and photo degradation properties of different types of dye doped optical fibers have been measured and compared in detail. We also realized Whispering gallery mode (WGM) resonators using a dye doped hollow polymer optical fiber and its theoretical modelling has been done using COMSOL Multiphysics software package. The possibility of unidirectional emission from deformed annular cavity is also discussed and compared its performance with simulation results. Multimode laser emission characteristics from photo pumped thin film polymer films deposited on silica core optical fibers are investigated. Lasing characteristics of microring embedded in the inner wall of the silica capillary and their dependence on the thickness of the microring cavities are presented. Almost single mode lasing with good side mode suppression is also demonstrated in our study. The work has resulted in arriving at major conclusions relevant to understanding and optimizing the features of performance of dye-doped polymer based waveguides crucial to their scope for applications in the area of Optoelectronics.

The expert in anything was once a beginner

Helen Hayes

New comers

Post Doctoral Fellow	Research Area	Mentor
Dr. Rehana P Ummer	Magnetic nanoparticle incorporated TiO_2 polymer hybrid membranes with photocatalytic and antimicrobial properties for water purification	Prof. Pramod Gopinath
Dr. Md. Zaheer Ansari	Applications of laser speckle imaging	Prof. A Mujeeb

PhD Scholar	Area of Research	Guide
Mrs. Keerthana S H	Studies on laser speckle techniques for metrology	Prof. A Mujeeb
Mr. Praveen P	Synthesis and characterization of thin film solar cell	Dr. Saji K J
Ms. Fathima R	Investigations on certain noble metal nano particles for photonic and related applications	Prof. A Mujeeb
Mrs. Cicily Rigi V J	Large scale synthesis of transition metal dichalcogenides and its application in transistors	Dr. Saji K J
Mrs. Lakshmi B	Magneto plasmonic studies on metallic and dielectric nano structures	Prof. Pramod Gopinath
Ms. Divya D Pai	Spectroscopic investigations of laser produced plasma	Prof. Pramod Gopinath
Ms. Soumya S	Chalcogenide glasses for photonic devices	Prof. Sheenu Thomas
Mrs. Safna Saif	Photonic crystal based devices	Dr. Priya Rose T

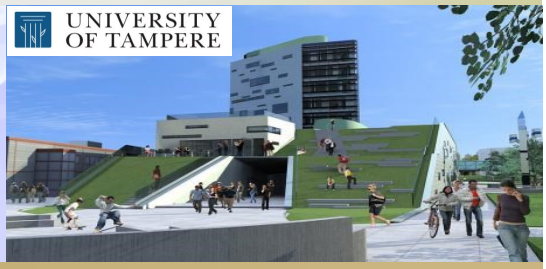
Our Collaborators

Amith K & Abhishek H Palmer of M.Sc have Worked on the Project Regarding the Evaluation of Performance of Double Bumped Gallium/ Erbium Gallium Doped Optical Fiber Amplifier

Multimedia University, Malaysia

Abhishek Ranjan of M.Sc has done the project on Second Harmonic Generation From Glass Using a Two Beam Technique in association

Tampere University of Technology, Finland



Aswani G S of M.Sc has done a project on Structural, Optical and Electronic Properties of MoS_2 Layers

King Abdullah University of Science and Technology, Saudi Arabia

Haritha K of M.Sc has Worked on the Project onTowards Protein Sensing and Trapping Using Plasmonic Devices

Okinawa Institute of Science And Technology, Japan

Varun Raj K of M.Sc has worked on Fempto Second Laser Pulse Width Measurement Using Auto Correlation Technique and Laser Mcromatchining

IIT Madras

Mohamed Nijas V of M.Sc. has Worked on Fiber Based OCT for Clinical Applications

IIT Hyderabad

Implementation of Experimental Demonstration Setup For Bb84 Quantum Bey Distribution By Using Classical Based Laser Source, Neha K Nasar - RRI, India

Setup Of Portable Doppler Free Saturation Absorption Spectrometer And The Hyperfine Spectroscopy Of Rubidium, Mary Ida Melody K S - RRI, India

Investigation Of X Ray Emission From Laser Induced Plasma, Jyothis Thomas Raman RRI, India

Dose Evaluation Using Collapsed Cone Convolution, Deepak Divakaran M T- IISc Bangalore, India

ISP

Faculty

Dr. A Mujeeb

Professor & Director

Dr. M Kailasnath

Professor

Dr. Pramod Gopinath

Professor

Dr. Sheenu Thomas

Professor

Dr. Saji K J

Assistant Professor

Dr. Manu Vaishakh

Assistant Professor

Muhammed Rishad K P

Assistant Professor

Dr. Priya Rose T

Assistant Professor

Dr. V P N Nampoori

Emeritus Professor

Dr. P Radhakrishnan

Emeritus Professor

Dr. C P Girijavallabhan

Visiting Professor

Dr. T R Ananthakrishnan

Visiting Faculty

Dr. A Varadarajan

Visiting Faculty

Dr. M Rajendran

Visiting Faculty

Dr. Bini P Pathrose

Assistant Professor
[On Ccontract]

Mr. Retheesh R

Assistant Professor
[On Contract]

Administration

Mr. Siraj S

Section Officer

Invited Lectures

Talk by ISP professors at various institutions

Prof. A Mujeeb

- Special address at Investiture Ceremony at Najath Public School, Kalamassery Kochi on 29 July 2017.
- Lecture on "Laser Assisted non-destructive testing of materials" at Department of Physics, Payyannur Campus, organized by UGC HRDC, Kannur University on 14 March 2017.
- Lecture on "Ultra-fast lasers for nano material synthesis" at Department of Physics, Payyannur Campus, organized by UGC HRDC, Kannur University on 14 March 2017.
- Lecture on "Laser speckle techniques for non-destructive evaluation of materials" at CAPE College of engineering, Kidangur on 7 March 2017.

Prof. M Kailasnath

- Invited talk on "Plastic fibre lasers" at STTP, Kidangoor Engineering College, Kottayam on 8 March 2017
- Invited talk on "Micro ring lasers for Sensing applications" in National Seminar on nonlinear optical materials and devices, Cochin College, Kochi-22 on 19 February 2018.

Prof. Pramod Gopinath

- Invited talk on Optical Nonlinearity in ZnO and its hybrids with graphene and carbon nanotubes at the International Topical Meeting on Applied and Adaptive Optics at the Indian Institute of Space Science and Technology, Thiruvananthapuram during 11-13 August 2017.
- Invited talk on High Power Lasers and Laser Produced Plasma at the Workshop on Photonics organized by Srinivasa Ramanujan Institute for Basic Sciences and School of Pure and Applied Physics, M G University at Kottayam during 19-21 May 2017.

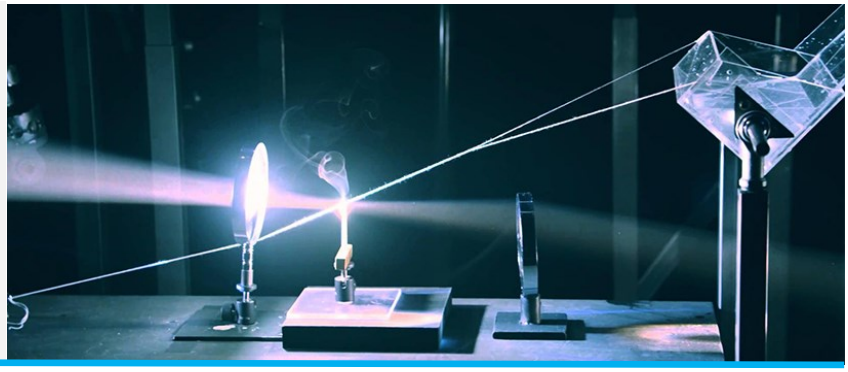
Dr. Manu Vaishakh

- Addressed the participants at the workshop conducted by Asian Academy of Laser Therapy at Marriott hotel 15 January 2018.

Dr. Saji K J

- Invited talk in National seminar on recent trends in Nano and Other Materials for Energy Efficient Devices 21 July 2017.
- Invited talk on Invisible Electronics at SH College, Chalakkudy in connection with Physics Association Inauguration. 13 October 2017.
- Invited talk in Frontiers & Developments in Materials Science at Govt. Victoria College, Palakkad 14 November 2017.
- Invited talk on "Recent advances in professional electronics and optoelectronics", St. Michael's College, Cherthala 23 November 2017.

Technical Events at ISP



Inculcate 2017

INCULCATE, a science propagation program was organised, in assistance with the Kerala State Science and Technology Museum and Priyadarsini Planetarium, from 20th to 23rd May 2017 with Dr. Priya Rose T as the co-ordinator. Faculty members from many other departments were also involved in co-ordinating the program. The main objective of the program was to provide opportunities to selected school students to meet eminent scientists, to attend their lectures and to take part in laboratory activities. As part of the program, a visit was organised to the Centre for Science in Society (C-SiS), CUSAT. After the four day program, selected students were also awarded scholarships by the KSSTM.

Ongoing Projects at ISP

Principal Investigator	Title	Funding Agency
Dr. Sheenu Thomas	Chalcogenide nano materials for Photonic device applications	KSCSTE

National Photonics Symposium 2017

The International School of Photonics, Cochin University of Science and Technology organised the 2nd National Photonics Symposium, NPS-2017 from 27th February to 1st March, 2017. The focal theme of the symposium was " **Recent Trends in Nanophotonics".** The purpose of the symposium was to inspire budding scientists to explore novel directions in scientific research through active discussions and collaborative research. It provided an excellent platform for participants to exchange ideas related to latest and advanced research activities with specialists and scholars from the respective fields. For this, experts from many research groups were invited to give lectures and plenary talks. NPS-2017 started off with an inaugural function. The welcome speech was given by Prof. A Mujeeb, Director of ISP. Prof. J. Letha, Hon. Vice Chancellor, CUSAT graced the occasion with her presence and also gave the inaugural address. It was followed by the release of proceedings and the release of photonics news-2016 by Prof. M K Jayaraj, Syndicate Member, CUSAT. Prof. P Radhakrishnan (ISP) and Prof. Sushil Mujumdar (TIFR, Mumbai) also gave felicitations. The awards for the toppers of MSc. Photonics and MTech Optoelectronics and Laser Technology courses and the awards for the best project presentation and the best researcher were also distributed in the occasion by Hon. Vice Chancellor. The inaugural function concluded with the vote of thanks by Dr. Saji K J, who was the coordinator of NPS 2017.The inaugural function was followed by lectures of various eminent scientists and professors, who were invited for the symposium. The first invited lecture was given by Prof. Sushil Mujumdar, TIFR Mumbai on "Anderson localization and Levy sums in random lasers". It was followed by a talk by Prof. Abdul Khader, Kerala University on "Charge transport in strongly coupled quantum dot solids". The next lecture was by Prof. Reji Philip, RRI Bengaluru on "Nanostructuring by ultrafast lasers and its applications in laser produced plasmas" followed by a talk by Dr. V R Supradeepa, IISc, Bengaluru.

The second day started off with a lecture by Dr. Ramesh Varma, USA on "Semiconductor Surfaces and Interfaces". Dr. Rajeev Kini, IISER, Thiruvananthapuram gave the next talk on "Light-matter interaction in quantum regime". It was followed by a talk by Prof. A R Ganesan, IIT Chennai on "Optical methods in Non-Destructive Testing and Evaluation" and by Mr. Arun, IISc Bangalore (Former ISP student). The last day witnessed talks by Prof. C Vijayan, IIT Chennai on "Nanophotonics" and Dr. Bhuvanesh Ramakrishna, IIT Hyderabad. The final lecture of the symposium was given by Prof. M K Jayaraj. There were a total of 7 oral and 18 poster presentations. The symposium concluded with a valedictory function on 1st February at 4.00 pm. Prof. C. P. Girijavallabhan, founder director of ISP was the chief guest for the function.

International OSA Network of Students Conference, IONS 2017

The International OSA Network of Students (IONS) conference, an event sponsored by the Optical Society of America (OSA), conducted across the world throughout the year, was this time, hosted by the ISP, CUSAT. The conference conducted successfully from September 11th to 14th, 2017 was co-hosted by the Indian Institute of Science, Bangalore. ISP was selected to host the conference owing to its large OSA student chapter strength and significant chapter activities, and is the first and the only institute in Kerala to receive this honour. The registered attendees included research scholars, post-doctoral fellows, graduates and undergraduates from IITs (Indian Institute Of Technology), NITs (National Institute Of technology), IISERs (Indian Institute of Science Education And Research), IISc (Indian Institute of Science) and various public and private universities and colleges, across the country. There were also foreign participants from Israel and Ireland.

IONS Kochi 2017 focused mainly on quantum optics and quantum computing, a dynamic and swiftly advancing field in optics. Hosted at the Seminar Complex, CUSAT, the four-day event was inaugurated in the presence of honourable vice chancellor of CUSAT, Prof. J Letha. The inaugural function had the esteemed presence of Dr. Rajan Jha, assistant professor, IIT Bhubaneswar, Dr. M. Mitchell (group leader, ICFO), Dr. Sushil Mujumdar (Principal investigator, TIFR), Prof. C P Girijavallabhan (founder director, ISP), Dr. A Mujeeb (director, ISP) and Mr. Muhammad Rishad (OSA-ISP chapter advisor).

There were lectures on various enlightening topics, starting with the one given by Dr.Rajan Jha on optical fibre sensors- principles to practice. This was followed by a lectures by Dr. Sushil Mujumdar , Dr. Morgan Mitchell , Prof. Ajoy Ghatak , Prof. Prem Kumar, Dr. Urbasi Sinha and Prof. R P Singh To encourage and uphold networking among different OSA chapters and its members, there was a cultural night followed by a banquet dinner on 12th, the second day of IONS. Also, a trip was organized to the Athirapally-Vazhachal waterfalls on the 13th of September. IONS Kochi concluded with a valedictory function in the afternoon of 14th September. The valedictory address was given by the pro vice chancellor of CUSAT, Prof. P G Sankaran. IONS Kochi exceeded our expectations, in its large student participation and acceptance among student and academic community.

Kerala Science Congress Curtain Raiser Program 2018

The curtain raiser program of the 30th Kerala Science Congress, jointly organised by the Kerala State Council for Science, Technology and Enviornment (KSCSTE) and the International School of Photonics (ISP) was held at the C.V. Raman Auditorium at ISP, on 10th January, 2018. It was attended by Prof. A Mujeeb, Director of ISP, Dr. C. Anil Kumar, Principal Scientist, KSCSTE, Prof. Sunil. K. Narayanankutty, Controller of Examinations and Dean of Faculty of Technology, CUSAT, and Dr. V. B. Kiran Kumar, Asst. Professor of the Dept. of Mathematics, CUSAT and KSCSTE Young Scientist Awardee. The welcome speech was given by Prof. A. Mujeeb following which a briefing on the Kerala Science Congress was given by Dr. C. Anil Kumar. The curtain raiser program was inaugurated by Prof. Sunil. K. Narayanankutty and felicitations to the program was given by Dr. V. B. Kiran Kumar. The official function concluded with the vote of thanks by Dr. Priya Rose T, Asst. Professor, ISP after which a special talk on "Renewable Energy" was given by Prof. V. P. N. Nampoori, Emeritus Professor, CUSAT.

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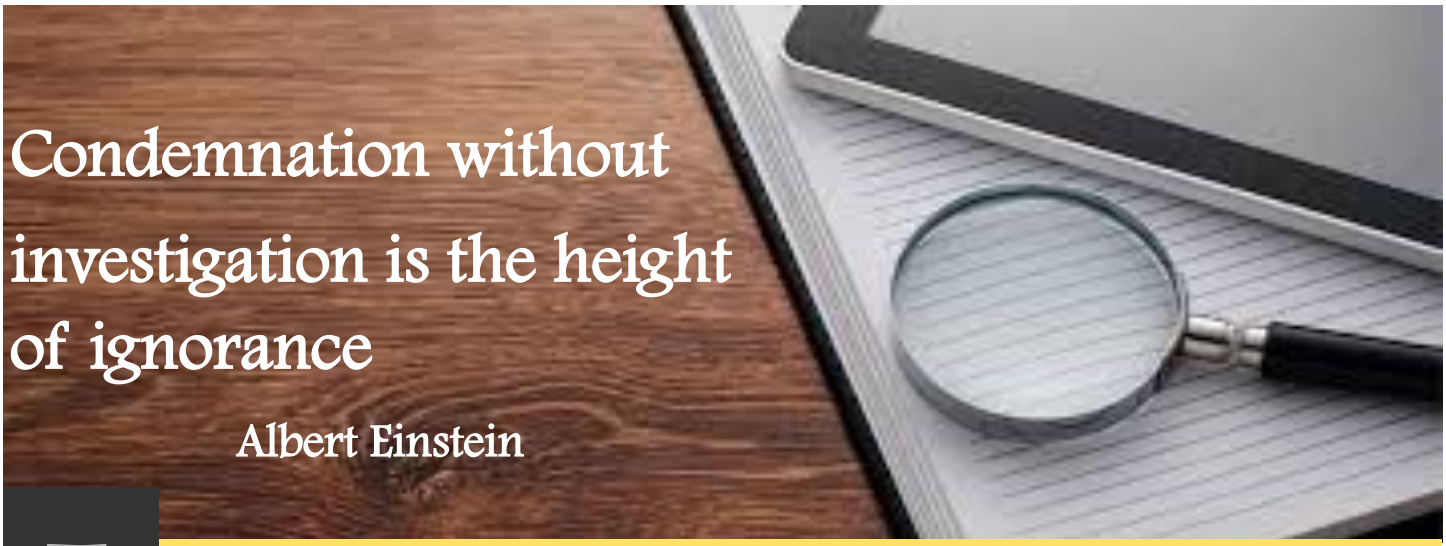
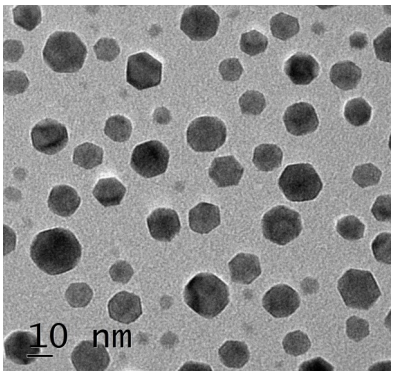


Insiders Investigations

Articles from Our Laboratory

Adrine Correya

Bismuth-bismuth oxide core-shell hexagonal nanoparticles having enhanced fluorescence



Bismuth Oxide nano particles

Bismuth and its oxide composites have interesting physical properties that have been well studied. These properties have been little studied in conjunction with its optical properties, especially with the bismuth titanate family. Reports of variations on physical properties depending on external fields for such materials opens up a huge window for exploring the optical properties of these materials during such perturbation. Studies on bismuth oxides and titanates are in progress towards revealing both linear and non-linear optical properties as well as their variations in external fields. Synthesis of highly crystalline bismuth-bismuth oxide core shell nanoparticles has been carried out in our lab and further optical characterization is being continued. Bismuth oxide has one of the highest known ionic conductivity in metal oxides and hence can be used as a multifunctional oxide conductor in specialized photovoltaic cells. Bismuth titanates are family of 50+ composites having the Aurivillius phase, known after their discoverer. These composites have the well known perovskite structure and have a great number of fascinating physical properties. The base compound of these composites, bismuth titanate itself has been reported for having external field dependent properties and even second harmonic generation owing to its non centrosymmetric crystal structure. Bismuth titanate also forms other phases like pyrochlore and sillenite, which have various other properties. Bismuth titanate nanocrystals as well as their thin films have been synthesized and are being characterized for optical properties.

Ajina C

Chalcogenide glasses for Surface enhanced infrared absorption

IR spectroscopy is a powerful technique for characterizing molecules and chemical reactions. Though this non-destructive non-invasive technique has the potential to compete with other composition analysis methods like XPS, EDS etc., it is suffering from its low detection limit. A promising solution to enhance the sensitivity of IR spectroscopy is to attach or place these analyte molecules very close to metal island structures. This is termed as SEIRA. Surface Plasmon Resonance (SPR) are the key mechanism responsible for this enhanced IR absorption. As the SPR frequency can be tuned with metal type, size, shape etc. several studies have conducted since its first discovery with different metals (Au, Cu, Ag, Pt), of various morphologies (films, nanorods, nanoshells).For a n even better response from SEIRA, optical waveguides or substrates on which these metal nanostructures are fabricated must be having high transparency in the IR region. Even though there are reports inferring the significance of substrate properties on SEIRA response very less attention is drawn into developing better substrate for IR spectroscopy. Chalcogenide glasses are promising host for the same as they are highly transparent in this region. In addition to this, they have flexibility in fabricating waveguide structures like optical fibers, planar wave guides, photonic band gap structures etc. for developing advanced sensor platforms.We are analyzing the usefulness of a pseudo binary chalcogenide glass of composition GeSeTe as a better substrate for SEIRA. For this, we have fabricated chalcogenide glass thin film waveguides over silica micro slides on to which silver islands are deposited via oblique angle deposition. Silver island is not only beneficial for the sensitivity enhancement but also is helpful in bio-functionalization of the core layer. The parameter optimization is done by recording and analyzing FTIR transmission spectra.

New Additions to ISP Laboratory

Andor SR-500i Spectrometer

The USB 2.0-based iDus spectrometer is a compact, yet feature-rich platform suitable for demanding spectroscopy applications such as low-light UV/ NIR Photo luminence or Raman spectroscopy, as well as day-to-day routine laboratory operation and integration into industry-grade systems.

TEKTRONIX DPO70604C Oscilloscope

The Tektronix DPO70604C with 4 analog channels has a high signal-to-noise ratio and smallest anomalies affecting the DUT's performance. Bandwidth enhancement and User-selectable filters for each channel provide magnitude and phase correction for more accurate representation of extremely fast signals.

Jessy Simon

Synthesis and characterisation of nano photonic materials

Synthesis and optical properties of metal nanoparticles are of primary importance due to their unique properties which are different from those of bulk materials. Among them, gold nanoparticles have been very attractive and are widely used for optoelectronic and biomedical applications. The interaction of light with surface electrons on gold nanoparticles would lead to their collective oscillation called Surface Plasmon Resonance (SPR) resulting in strong absorption of light at specific wavelength. The particular wavelength at which SPR occurs is characteristic of the gold nanoparticle size, shape, morphology and agglomeration state. Gold nanoparticles can be prepared by various methods like chemical, physical and biological. Chemical method involves the reduction of metal ions and the chemisorption of ligands on the surface of metal ions to prevent them from coagulation. Physical method makes use of different approaches such as evaporation/condensation and laser ablation of metal targets. Biological method synthesizes gold nanoparticles with the help of naturally available materials as reducing agents.

Pooja Gitty

Lanthanide doped calcium phosphate nanomaterials

Calcium phosphate is the major inorganic component in bones and teeth of animals and humans. Due to its excellent bioactivity, biocompatibility calcium phosphate is widely investigated and promoted in all research areas. Lanthanides, also called rare -earth elements, are the family of elements between lanthanum and lutetium. Lanthanide ions have similar ionic radii to Ca^{2+}, but because of the higher charge, they have a great attraction for Ca^{2+} sites on biological molecules. The high affinity of lanthanides for bone has been known for decades, due to their ability to replace Ca^{2+} ions in hydroxyapatite, a calcium phosphate ceramic material. The presence of lanthanide ions in the hydroxyapatite(HA) crystal structure appears to affect the bone metabolism inducing changes in the bone composition, crystal size and lattice structure, as documented in experimental and clinical data. In vitro studies also reported evident effects on bone cells. As a consequence, inclusion of these elements on the composition of calcium phosphate biomaterials for bone tissue regeneration has also been considered, and reported to induce promising changes in the physicochemical and biological profiles. Incorporated Ln^{3+} in the HA matrix include (La^{3+}), (Y^{3+}) and (In^{3+}), (Sm^{3+}) and (Gd^{3+}) and, also, in nanostructured HA, namely (Ce^{3+}) and (Ce^{3+} & Sm^{3+}). HA and TCP lanthanum phosphate composites have also been reported. Recently, the primary tests concerning the adherence of Enterococcus faecalis ATCC 29212 (Gram-positive bacteria) to samarium doped hydroxyapatite showed high antibacterial activity. The antibacterial properties of Sm:HAp-NPs can lead to increasing their applicability in medical or environmental area. They are also employed in biological imaging, drug delivery systems . 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.

Anitha Prakash

Interaction of metal nanoparticles with dye molecules

Metallic nanoparticles display strong optical absorption phenomena in the visible region due to coherent oscillations of electrons, have been extensively used to alter the properties of organic molecules. Manipulation of the characteristics of dyes using metallic nanoparticles have attracted the research world for diverse applications in the field of optoelectronics and photonics. Different types of dyes such as natural and synthetic dyes are utilized for such research purpose. Among the different types of dyes, the interest on organic dyes is because of its number of properties such as, the ease with which structural modifications can be made, and the compatibility and its availability. The organic dyes can also be used as solid state host 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. Thus, doping of dye on different materials like metallic nanoparticles give more scope for further research for specific applications. Interaction of noble metallic nanoparticles with dye molecules and their impact on the optical properties of fluorescing dye molecules, is an important research area in nanotechnology due to their promising applications in diverse fields, such as material science, optoelectronics and biomedical applications. A number of researches are going on the linear and non-linear optical characterization of noble metallic nanoparticles incorporated dye molecules, which can be effectively used for make efficient photonic applications.

Lakshmi B

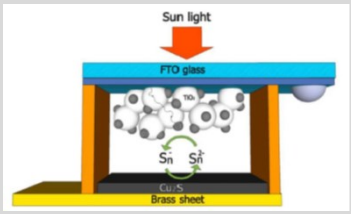
Magnetoplasmonics - Combining magnetism and plasmonics

Magnetoplasmonics, a field intertwining magnetism and plasmonics, is an active research area in nanophotonics. It enjoys the features of both magnetism and plasmonics and offers excellent multidisciplinary applications. The magneto-optic behaviour is brought into the system by the magnetic part while the plasmonic behaviour is brought in by the noble metallic part. The research interests in magnetoplasmonics goes in a two-fold manner; one is in enhancing the magneto-optical (MO) activity of the system using strong electromagnetic field confinement property of plasmonics, the second is controlling the plasmonic properties of the system with an applied magnetic field. Though the theoretical concepts of magnetoplasmonics has been known since 1970s, it is the helping hand of nanotechnology that has triggered research activities in this field at a very great pace. Magnetoplasmonics has applications in many different areas the most important being in telecommunications and sensing. The magnetic field induced modification of plasmonic properties of a magnetoplasmonic system helps in the development of active plasmonic devices such as optical integrators, modulators, rulers etc whereas the sensitivity of plasmon resonance frequency to the refractive index of the surrounding dielectric medium can be used in developing sensors which can be used in gas and biosensing applications. Thus, summarising, magnetoplasmonics offers many novel concepts which can provide considerable impetus to the advancement of the field of nanotechnology.

Ramya M

Quantum dot Sensitized Solar Cells

The research and development of Quantum Dot Sensitized Solar Cells (QDSSCs) has been strongly stimulated and they could be an alternative for the next generation of solar cells. The unique characteristics of fluorescent semiconductor nanoparticles or Quantum Dots (QDs), such as tunability of the bandgap, high absorption coefficient and generation of multiple electron carriers under high energy excitation, make them good candidates for this type of sensitized solar cell .Wide band gap semiconducting materials not effective in DSSC fabrication. Using these materials, it may not be possible to utilize the full solar spectrum which leads to a limited short – circuit photocurrent density. Due to this reason, most of the QDSSC fabrication narrow bandgap QDs are used. QDs such as CdS, CdSe, CdTe, PbS, PbSe, $CuInS_2$ and $CuInSe_2$ with narrow band gap and high conduction band edge provide the great potential for the fabrication of QDSSCs. The efficiency of QDSSCs are still less than dye -sensitized solar cells. The moderate performance in QDSSCs is due to the undesired photo-generated electron recombination in both internal QDs and interfaces of QD/TiO_2/electrolyte due to high density of trapping states on QD surface. Using core- shell structured (type I / type II) QDs with characteristic of wide light harvesting range, high conduction band edge and low charge recombination rate is an effective route to minimise the recombination rate and enhance the efficiency.



Schematic diagram of QDSSC

Sony U

Studies on solvent induced fluorescence properties of Styryl dye

The Styryl group of dyes has been used in cellular studies for over 50 years because of their Solvatochromic and/ or electrochromic properties. In Styryl dyes for example LDS 798, the rotation of the C–C bond connecting the quinolinium head region and the dimethylaminophenyl tail would lead to intramolecular charge transfer, thus turning LDS 798 into a molecular rotor, which might be capable of responding to changes the in microviscosity of the environment. Moreover, the presence of the dimethylamino-group should make LDS 798 sensitive to the pH of the surrounding environment. Thus, if photophysical properties of the dye would depend on the viscosity of the media, Styryl dyes can be used as a molecular viscometer. The maintenance of an appropriate pH within membrane enclosed compartments is a constant challenge for all living beings, from the simplest prokaryotes to complex multicellular organisms. In mitochondria, cytochromes exploit the flux of electrons to extrude protons, thus producing a proton gradient that is used to generate useful chemical energy in the form of ATP. In contrast, other organelles consume ATP to pump protons into the lumen to generate the acidic pH required for the maturation and processing of secretory proteins and for the dissociation and recycling of endocytosed materials. Because most enzymes are exquisitely pH sensitive, the pH of each organelle critically determines the coordinated biochemical reactions occurring along the endocytic and secretory pathways. Aberrations of the normal organellar pH homeostasis, either through disease, infection, or by pharmacological means, can lead to significant functional changes. Cellular studies on LDS 798 dyes shows that the dye molecule can preferentially localizes in mitochondria and its fluorescence and absorption changes with change in pH. The lifetime and quantum yield studies are found to be directly proportional to viscosity in the absence of polarity changes. LDS 798 proved to be a multi-responsive probe.

Praveen P

Thin film solar cell

It is globally accepted that the direct conversion of solar energy to electricity is a vital solution to reduce the dependency on fossil fuel. In 1883 Charles Fritts developed first photovoltaic cell with 1% efficiency, with gold plated Selenium. In 1954, Bell Laboratories developed first practical solar cell with 6% efficiency, using silicon. Since silicon is an indirect band gap semiconductor and it has less light absorption coefficient, high amount of material is needed to harvest solar energy. The advancement in thin film technologies also leads to thin film solar cells. Non-silicon thin film solar cells offer a solution for the issues related to silicon-based solar cells. These kinds of cells use materials like cadmium telluride (CdTe), copper indium gallium diselenide (CIGS) or Cu_2ZnSnS_4 (CZTS). But the usage of hazardous materials like cadmium (Cd) or rare metals like indium (In) in a thin-film solar cell is troublesome. This problem can overcome by using CZTS thin film as an absorber layer, which does not contain rare metals, and also they possess extremely low toxicity. The CZTS film possesses promising characteristic optical properties; the band-gap energy of about 1.5 eV and large absorption coefficient in the order of 10^4 cm^{-1}. All constituents of this CZTS film, which are abundant in the crust of the earth, are non-toxic. Therefore, if we can use CZTS film practically as the absorber of solar cells, we will be free from both of the resource saving problem and the environmental pollution.

M M Raj Sha

Quantum dot solar cells

CO_2 Content in the atmosphere is alarmingly increasing. Increasing the CO_2 level is dangerous with respect to the global warming. The use of fossil fuels is one of the major reason for the increase of CO_2 in the atmosphere. In order to reduce the CO_2 level and control the global warming, reduction in the conception of the fossil fuels and usage of renewable energy sources are recommended. At the same time, the world requirement of energy is expected to be increased (20-30) % in the next decade. Hence better technologies and sustainable energy solutions to be focused on research. Photovoltaic energy conversion is one of the most promising alternatives. 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, Up conversion/down conversion based solar cells, impurity band, Intermediate-band solar cells and perovskite solar cells etc. QD solar cells are promising among third-generation solar cell technologies and it uses QD as the absorbing layer. QD are semiconductor nanoparticles having the size less then Bohr exciton radius. QDs allows tunable energy bandgap without changing the size of the particle in the same material. One of the largest loss in the Bulk and thin film solar cells happens when the photon with higher energy than the band gap of the absorbing layer produced carriers with excess kinetic energy; which dissipates by phonon emission. QD structures make quantum confinement effects can be used to control energy flow, and it has potential to reduce this type of loss. The improvements in the photovoltaic devices ultimately lead to the reduction of usage of fossil fuels and tackling of CO_2 in a controllable manner.

Anand V R

Thermo–Optic Tuning of Whispering Gallery Mode Lasing from a dye-doped Hollow Polymer Optical Fiber

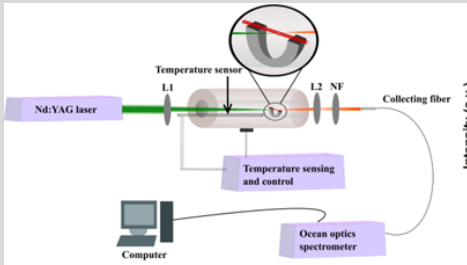


Fig. 1. Experimental set up, P1and P2 -polarizers, L1 and L2-convex lenses, NF-notch filter.

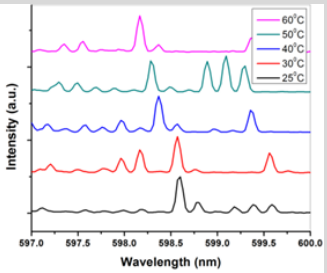


Fig. 2. Lasing spectra of the hollow fiber as a function of measured temperature

Tunable optical microresonators with high optical quality, small size, and flexibility are the key enabling elements for many photonic integrated circuits (PICs). A special class of monolithic optical resonator with circular shape is referred to as the Whispering Gallery Mode (WGM) resonators, which have high quality factor (Q), small mode volume (V) and very narrow spectral linewidths. The WGM microcavity can take either the form of a microsphere or micro disk or micro fiber. Polymer dye doped micro fiber is a good candidate for low-threshold lasing with advantages such as low cost, mechanical flexibility and easy fabrication. WGM resonance spectrum is ultra-sensitive to the cavity size and effective refractive index. Resonance spectrum of WGM resonators with high electro-optic coefficients are tuned electrically and those with good mechanical properties like flexibility can be tuned mechanically. If the tuning method causes irrecoverable changes in the effective cavity size or effective refractive index, the tuning scheme is irreversible. In the case of materials with high thermo-optic coefficient and thermo-expansion coefficient, tuning of WGM lasing can be possible by thermo-optic means. Temperature tuning of WGM microlasing from optically pumped dye-doped emulsion microdroplets of cholesteric liquid crystals is also reported. But this type of lasing has disadvantages like less stability, low handling feasibility, less control over evaporation and diffusion of the dye to the carrier. A heat drawn dye incorporated PMMA polymer optical fiber can overcome the above mentioned shortcomings.

Soumya S

Chalcogenide glasses for photonic devices

Research work on chalcogenide glasses of different compositions have potential applications in the field of Photonics because of its notable physical, optical, thermal and electrical properties. Chalcogenide glasses are inorganic glassy materials and are made of one or more chalcogen element which consists of sulphur, selenium, tellurium with the addition of other elements such as, arsenic, germanium, gallium, antimony. Some of the important characteristics of chalcogenide glasses over silica and fluoride glasses that renders them to use in photonic devices applications of low power band width, high refractive index, high optical nonlinearities, high optical transparency and unique photodoping. Chalcogenide glasses are promising candidate mainly for biosensing and chemical sensing applications since they have wide optical windows in mid-infrared regions that allows them to collect the complete vibrational spectrum of biomolecules. Chalcogenide glasses are widely used in passive applications which include the passive devices such as lenses, windows, fibres and are extensively used in active applications such as laser fibre amplifiers and non-linear components. Metal chalcogenides with wide band gap are used in nonlinear optical applications. Chalcogenide glassy materials can be used as photovoltaic solar cell materials and also in read-write storage devices because they can rapidly switch back and forth between amorphous and crystalline phases on the application of heat pulses. Chalcogenide glassy material based devices are highly sensitive and cost effective devices. They have a numerous potential applications in civil, medical and military areas. The area of chalcogenide glass is still open for further investigations

Cicily Rigi V J

2D Transition metal dichalcogenides for application in transistors

With the discovery of graphene and its extra ordinary properties, many 2D materials, that can form atomic sheets also gained importance. Among them two dimensional transition metal dichalcogenides (2D TMDCs) have led to a variety of promising technologies for nano-electronics, photonics, energy storage and opto electronics to name a few. TMDCs are two dimensional layered van der Walls materials. In each layer they have a transition metal (M) e.g. Mo, W, Nb, sandwiched between two layers of chalcogen atoms(X) e.g. S, Se, Te. TMDCs like MoS_2, $MoSe_2$, WS_2, WSe_2 etc are almost as thin, transparent and flexible as graphene. Unlike graphene these 2D TMDCs are semiconducting in nature and have direct bandgap in monolayers. So they are considered as an excellent choice for channel material of field effect transistors and it is expected that by using these materials, it will be possible to continue miniaturization much beyond the physical limits of current silicon based technology. Even though 2D TMDCs exhibit a breadth of new properties, developing such materials into large-scale and defect-free atomic layers with thickness controllability on desired substrates is challenging. The methods like micro mechanical exfoliation, atomic layer deposition, molecular beam epitaxy, chemical vapour deposition etc used nowadays, have demerits of their own. So industry viable radio frequency magnetron sputtering method can be used as an alternate method for the current techniques used. The advantages of the sputtering technique such as low temperature, low power synthesis, layer controllability etc could be utilized efficiently so as to produce good quality 2D TMDCs.

Ishaq Ahamed A

Optical sensing of chlorinated water using different waveguide structures

Fiber optics sensors appear as diligent panacea for a wide variety of sensing applications and here we can utilize its splendid and unique possibilities for the sensing of chlorine present in water. The unparallel demand for conservation of scarcely available drinking water in the earth is an alarming fact before humankind. Such a scenario obviously put forward the need for impetus research for monitoring of water chlorination, which is the one and only widely accepted water disinfection method used all over the world. As the fact says, the lower amount of chlorination will affect disinfection process and over chlorination causes many water borne diseases. Thus a novel and economical setup for chlorine sensing appears important as it is socially relevant also.A range of different schemes for the determination of chlorine content (hypochlorite) in water are used such as iodometric, coulometric, polarographic, chemiluminescence, radiolytically-induced redox, normal pulse voltametry, colorimetric and potentiometric methods. However fiber optic chlorine sensing using different methodologies such as evanescent wave absorption spectroscopy, Surface Plasmon Resonance (SPR) etc standout as a unique technique with a numerous advantages compared to other techniques. N,N-diethyl-p-phenylenediamine (DPD) based spectrophotometry is a conventional technique for free chlorine determination because of its high sensitivity and selectivity. Chlorine oxidizes the DPD amine to two oxidation products. At a near neutral pH, the primary oxidation product is a semi-quinoid cationic compound known as a Würster dye. The absorption spectrum of the DPD Würster dye indicates a doublet peak with maxima at 512 and 553nm. This DPD chemistry is utilized to set up an evanescent wave fiber optic sensor using decladded PCS(Polymer Cladded Silica) fiber for chlorine sensing.

Divya D Pai

Spectroscopic Investigations of laser produced plasma

Plasma, the fourth state of matter is a gas of positive ions, electrons and neutral particles. By irradiating a solid target with an intense laser beam for a short interval of time, a hot plume called plasma is generated over the target surface due to melting, ionization and ejection of the surface material of the target. An in depth understanding of evolution dynamics of laser produced plasma expanding in a transverse magnetic field in vacuum or in the presence of ambient gas has gained much importance due to its applications in the field of spectroscopy and material science (Laser Induced Breakdown Spectroscopy (LIBS), Pulsed Laser Deposition (PLD), Extreme Ultraviolet Lithography), High Energy Density Physics (Inertial Confinement Fusion, energetic ion generation, proton acceleration, X-ray production) and space physics (study of artificial comets, stellar wind, plasma accelerators for space propulsions). The plasma diagnostic techniques such as Optical Emission Spectroscopy (OES), Fast-gated Imaging with Intensified Charge Coupled Device (ICCD), Time Of Flight (TOF) and Laser Induced Fluorescence are widely in use to determine plasma parameters. OES gives information on chemical composition of the plasma. The spatial variation of OES of plasma gives information on evolution in electron density and electron temperature of plasma expanding across transverse magnetic field in the presence of ambient gas. Fast-gated ICCD imaging provides spectrally integrated plume images at different delays after the laser pulse. Spectrally resolved plume images can also be captured by using suitable band pass filters in front of the spectrometer coupled with ICCD. A fast-gated imaging study provides accurate description of plasma evolution and expansion regimes. TOF profiles at different distances from the target surface helps to obtain a plot of temporal location of maximum emission intensity as a function of distance from the target so that the slope provide the velocity of the plume species. Further, the analytical model predictions and simulations would better help to understand the laser plasma interaction with ambient gas and magnetic field.

Keerthana S H

Studies on laser speckle techniques for metrology

Speckle pattern is generated when a highly coherent beam undergoes diffuse reflection from a rough surface. If the laser illuminated surface undergoes deformation, the speckles appearing in the speckle field shows the displacement accompanied by the change in structure. Laser speckles are used to characterize diffuse surfaces. The speckle pattern is recorded on CCD camera and is then analyzed either by photographic method or by using digital techniques. Speckle phenomenon has so many advantages such as non-contact, full field, high accuracy measurements etc. So, it has become an important tool in optical metrology. In the present study, we intend to use the three different methods of speckle techniques such as speckle photography, speckle interferometry and speckle shearography for various applications. The proposed applications include determination of roughness of various optical materials, determination of thickness of thin films etc using the devised optical configuration. The quality of materials can be studied by the measurement of surface roughness and the suitability of a film can be noticed by evaluating the thickness. The results obtained will provide reasonable benefits to the society.

Fathima R

Investigations on Certain Noble Metal Nano Particles for Photonics and Related Applications

In recent years, remarkable growth in research, development and nanotechnology has opened new windows for exploration and utilization of various fascinating properties of nano particles (NPs). Due to these special and interesting properties, noble metal nano particles like gold, silver, etc., are catching attentions of researchers. They exhibit several interesting properties and innumerable applications, in various fields like photonics, photography, chemical sensing, catalysis, SERS, and most importantly in medical field as anti microbial agents, drug delivery and medical imaging. Applications also includes photo thermal therapy, solar cell, and as consumer products like detergents, paint, and cosmetics. Laser ablation, chemical synthesis and biological synthesis methods can be utilized for synthesis of NPs. The unusual optical properties of these noble metals like size dependant electro chemistry and high chemical stability makes them a key to explore various phenomena including self assembly, bio labeling, catalysis etc. The synthesis of stable and well dispersed noble metal NPs can give fascinating results. Spectroscopic techniques (UV-Visible, IR, and Raman scattering) will be employed for confirmation of the presence of molecular or chemical species, studying luminescence, fluorescence etc. Microscopic techniques (like SEM, TEM, STM, and AFM) will give the direct visualization of the morphology, particle size etc. Scattering techniques like XRD, DLS, etc. can be useful to find size, shape, number density and crystal structure.

Priyamvada V C

Fiber optic plasmonic sensors

Plasmonics is an ever exciting field of research, finding potential applications in the fields of scientific, industrial and medical applications. Optical fiber based plasmonic sensors are one of the maturing fields of plasmonic application, that provide fiber optic sensors of excellent performance in bio and chemical sensing applications. For the development of fiber optic plasmonic sensors, suitable optical fibers are selected. The selection of the fiber is based on the application, the better performance and ease of sensor fabrication. Most commonly, plastic cladded silica fibers are selected. Normally PCS fibers are having higher core diameter (> 100μm) and hence multimode. The removal of cladding from such fibers is comparatively easy compared to whole silica fiber. The large light gathering capacity, excitation of higher order modes and ease of uncladding make PCS fibers a good choice for sensor fabrication. Plasmonics is exhibited in metallic nano layers attached to a dielectric surface for which the core of an optical fiber can be selected. By selecting silver as the plasmonic element and a plastic cladded silica fiber as the dielectric surface plasmonic sensors were fabricated. For this purpose, thermal evaporation coating method was adopted using a vacuum coating unit. The fibers were uncladded to different unclad lengths; Silver nano layer is deposited on the cleaned core surface of the fiber. The sensor response in concentration sensing is recorded. Fibers having different sensing surface geometries were also developed. The performances of all these plasmonic fiber surfaces were evaluated. The thickness of the plasmonic silver layer was also varied. The sensor response for the different silver layer thickness was evaluated. Adhesion of silver to the core silica surface is a question of serious concern. To check this, the same sensor surface was repeatedly subjected to sensing measurements and performance variations were noted down.

Musfir P N

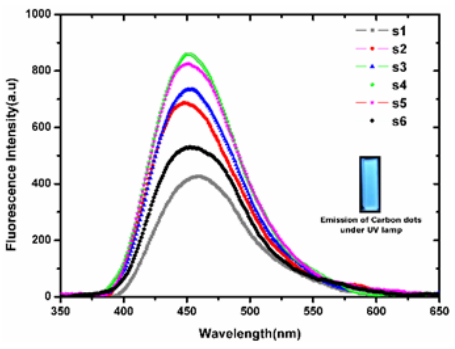
Dielectric relaxation and AC conductivity studies in chalcogenide glasses

Chalcogenide glasses have attracted much attention due to their potential applications in optoelectronic devices, solar cell, memory switching, infrared photo detectors and bio-sensors. A variety of applications including phase change memory, photo receivers, and change of electrical resistance have been reported using these glasses. Such dielectric materials have been widely employed in various industrial devices such as dynamic access memory microwave filter, voltage controlled oscillator and telecommunication technologies. Dielectric relaxation studies are important to understand the nature and the origin of dielectric loss which, in turn, may be useful in the determination of structure and defects in solids. As these materials are covalently bonded solids, the dispersion is not expected at low frequencies. However, recent measurements have indicated that dielectric dispersion loss does exist in these glasses even at very low frequency. The origin and nature of dielectric losses in these materials has, therefore, become a matter of curiosity. Frequency-dependent electrical conductivity of chalcogenide semiconductors is helpful to understand the conduction mechanism in their alloys. Therefore, it is interesting to study the electrical behaviour of these materials in AC fields which gives the important information about the transport process in localized state in the forbidden gap. AC conductivity and dielectric measurements have been reported for a wide variety of amorphous chalcogenide semiconductors in order to understand the mechanisms of conduction processes in these materials and type of polarization. Chalcogenide glasses are known to be structurally disordered system and the disorder in atomic configuration is responsible for the existence of localized electronic states within the material. Because the charge carriers are localized, a.c. technique is often employed to probe their behaviour. The a.c. conductivity, $\sigma_{a.c.}$, in many amorphous solids has been found experimentally to obey an equation of the type $\sigma_{a.c.}(\omega)=A\omega^{s}$, where ω is the angular frequency of the applied field, A is a constant and s (≤ 1.0) is the frequency exponent.

Vijesh K R

Optical properties of carbon quantum dots

Carbon nano materials with size less than 10 nm, generally termed as carbon dots (CDs), due to their easy availability, cost effectiveness and harmless disposition are finding potential applications in optronics, catalysis, sensor and Bio-imaging. Thermal and optical properties of fluorescent carbon dots (CDs) prepared from citric acid anhydrous as the precursor and ethylenediamine as the passivation agent by microwave assisted synthesis technique is explored in the present study. Optical absorption and emission spectra of carbon dots reveal the presence of surface states with an absorption peak around 350nm and emission around 450 nm.



Fluorescence of CDs

M.Sc Photonics 2012-17 Batch - Career at a Glance

Name of the Student	Designation	University or Organization
Abhishek Rajan	Doctoral Researcher	Tampere University of Technology, Finland
Amith k	Doctoral Researcher	École nationale supérieure des sciences appliquées et de technologie de Lannion, France
Aswani G S	Doctoral Researcher	Australian National University
Haritha K	Doctoral Researcher	University of Siegen, Germany
Jyothis Thomas	Doctoral Researcher	Ecole Polytechnique de Montreal, Canada
Mary Ida Melody K S	Doctoral Researcher	Raman Research Institute, Bangalore
Mohamed Nijas V	Doctoral Researcher	Indian Institute Of Technology, Hyderabad
Sarath M P	Master Student (MS)	Abbe School of Photonics, Friedrich Schiller University, Germany
Varun Raj K	Master Student (MS)	Abbe School of Photonics, Friedrich Schiller University, Germany.
Vinay Kumar	Doctoral Researcher	Karlsruhe Institute of Technology, Germany

Thursday Seminars

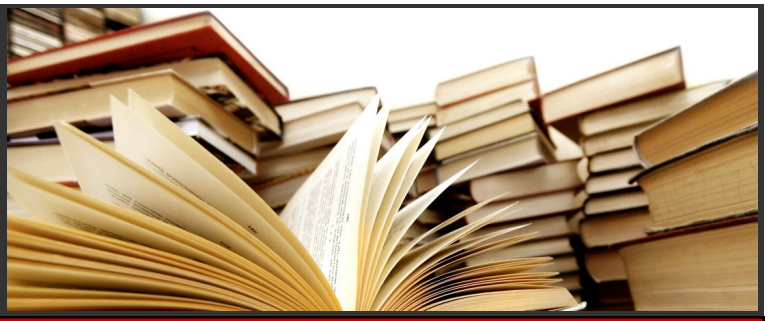
Weekly/special seminars are organized possibly on every thursdays by ISP members and invited guests. These seminars were sponsored by ISP Student's Chapters of SPIE, the International society for optics and photonics, Optical society of America and Photonics Society of India.

SEMINAR TOPIC	PRESENTED BY
Enhancement of hydrogen gas sensing of nano crystalline nickel oxide by pulsed laser irradiation	Pradeep Kumar V
Bio lasers for intracellular sensing applications	Prof. Kailasnath
How and why to measure laser beam quality	Dr. Sreenivasan Nair
Performance evaluation and enhancement techniques for intensity modulated earth-satellite free space optical links	Anjitha Viswanath
Laser safety	Dr. Sreenivasan Nair
Chemical safety	Dr. Mathew S
Quantitative imaging of heterogeneous dynamics in drying and aging paints	Keerthana S H
Beyond 8% ultrathin kesterite Cu_2ZnSnS_4 cells by interface reaction route controlling and self organized nanopattern at the back contact	Praveen P
Laser ablation as a method for synthesis of gold nanoparticles	Fathima R
Become a python expert	Shiju Prasad
Optical fibers for the collection of particles and photons	Roopa Venkataraj
Quantum dot sensitized solar cell	Nideep T K
Magnetoplasmonics and its applications	Lakshmi B
Surface snhanced snfrared sbsorption spectroscopy [SEIRA]	Ajina C
Schottky barrier reduction in transition metal dichalcogenide based transistors	Cicily Rigi V J
Towards zero-threshold optical gain using charged semiconductor quantum dots	Boni Samuel

Invited Talk by Erudite Scholars

TOPIC	PRESENTED BY
Plasmonic Biosensors	Dr. Susthitha Menon P IMEN, UKM, Malaysia
Interaction of QD with light and solid state environment	Dr. Shilpi Gupta, IIT, Kanpur
Novel material paradigms for Nanophotonics – from topographical insulators and perovskites to chalcogenide	Harish N Krishnamoorthy Nanyang Technological University
Organic solar cells: Towards green energy How to build an excellent academic C.V and cover letter.	Dr. Safakath Karuthedath KAUST, Saudi Arabia
Optical fibre sensors - principles to practice	Dr. Rajan Jha IIT, Bhubaneswar
Disordered amplifying media: From Levy sums to Anderson localization	Dr. Sushil Mujumdar TIFR, Mumbai
Bell Tests	Dr. Morgan Mitchel ICFO, Spain
Quantum nature of light and entanglement	Prof. Ajoy Ghatak IIT, Delhi
All optical switching for photonic quantum network	Prof. Prem Kumar, North Western University
A tale of three slits: from superposition to quantum computing	Dr. Urbasi Sinha RRI, Bengaluru
Optical vortices; its development and characterisation	Prof. R P Singh Physical Research Laboratory, Ahmedabad

Recent Publications



17 International journals and 18 International/National conference papers have been published in the year of 2017-18

Journal Publications

1. Mathew, S., Samuel, B., Mujeeb, A., Kailasnath, M., Nampoori, V. P. N., and Girijavallabhan, C. P. (2017). Effect of Au coating on optical properties of CdS nanoparticles and their optical limiting studies. Optical Materials, 72, 673-679.
2. Correya, A. A., Mathew, S., Nampoori, V. P. N., and Mujeeb, A. (2018). Structural and optical characterization of hexagonal nanocrystalline bismuth-bismuth oxide core-shell structures synthesized at low temperature. Optik-International Journal for Light and Electron Optics, 157, 930-935.
3. Venkataraj, R., Girijavallabhan, C. P., Radhakrishnan, P., Nampoori, V. P. N., and Kailasnath, M. (2017). Photochemical Degradation of Curcumin: a Mechanism for Aqueous Based Sensing of Fluoride. Journal of fluorescence, 27(6), 2169-2176.
4. Udayan, S., Ramachandran, V. K., Sebastian, M., Chandran, P., Nampoori, V. P. N., and Thomas, S. (2017). Effect of DNA-CTMA complex on optical properties of LDS 821 dye. Optical Materials, 69, 49-53.
5. Bini, P. Pathrose., Anitha, Prakash., V.P.N., Nampoori., P. Radhakrishnan., H. Sahira., and Mujeeb, A., (2018). Lasing and spectral characteristics of neutral red dye. Optik 156 ,988–993
6. Pathrose, B. P., Prakash, A., Nampoori, V. P. N., Radhakrishnan, P., and Mujeeb, A. (2018). Investigations of the of Ag nanosol impact on the nonlinear optical properties of neutral red dye. Optical and Quantum Electronics, 50(1), 26.
7. Udayan, S., Sebastian, M., Vijesh, K. R., Nampoori, V. P. N., and Thomas, S. (2018). Thermal diffusivity and lifetime studies of Styryl 7 dye on DNA-CTMA complex. Journal of Luminescence, 194, 428-432.
8. Vijesh, K. R., Sony, U., Ramya, M., Mathew, S., Nampoori, V. P. N., and Thomas, S. (2018). Concentration dependent variation of thermal diffusivity in highly fluorescent carbon dots using dual beam thermal lens technique. International Journal of Thermal Sciences, 126, 137-142.
9. Anand, V. R., Mathew, S., Samuel, B., Radhakrishnan, P., and Kailasnath, M. (2017). Thermo-optic tuning of whispering gallery mode lasing from a dye-doped hollow polymer optical fiber. Optics letters, 42(15), 2926-2929.
10. Samuel, B., Retheesh, R., Ansari, M. Z., Nampoori, V. P. N., Radhakrishnan, P., and Mujeeb, A. (2017). Cross-correlation and time history analysis of laser dynamic specklegram imaging for quality evaluation and assessment of certain seasonal fruits and vegetables. Laser Physics, 27(10), 105601.
11. Retheesh, R., Samuel, B., Radhakrishnan, P., and Mujeeb, A. (2017). Detection and analysis of micro cracks in low modulus materials with thermal loading using laser speckle interferometry. Russian Journal of Nondestructive Testing, 53(3), 236-242.
12. Sebastian, S., Kailasnath, M., Nampoori, V. P. N., and Asokan, S. (2017). Ag nanowire-assisted low threshold WGM lasing from polymer optical fiber. Optics letters, 42(19), 3820-3823.
13. Cheruvalath, A., Sebastian, I., Sebastian, M., Nampoori, V. P. N., and Thomas, S. (2017). Effect of midgap defect states on the optical properties of Ge20Se70Te10 nano colloids. Optical Materials, 72, 265-269.
14. Ansari, M. Z., and Mujeeb, A. (2017). Application of motion history image (MHI) on dynamic fluorescent imaging for monitoring cerebral ischemia induced by occlusion of middle cerebral artery (MCA) in mouse brain. Biomedical Spectroscopy and Imaging, 6(3-4), 135-142.

15. Koskinen, K., Slablab, A., Divya, S., Czaplicki, R., Chervinskii, S., Kailasnath, M., and Kauranen, M. (2017). Bulk second-harmonic generation from thermally evaporated indium selenide thin films. Optics Letters, 42(6), 1076-1079.
16. Samuel, B., Mathew, S., Correya, A. A., Nampoori, V. P. N., & Mujeeb, A. (2018). Surface defect assisted broad spectra emission from CdSe quantum dots for white LED application. Materials Research Express,5, 025009.
17. Alina C, kuriakose .,C,Pradeep., Nampoori, V. P. N., and Sheenu Thomas.(2018).Studies on the interaction between 7-(dimethyl amino)-4-(trifluoromethyl)-2H-1-benzopyran-2-one and cadmium sulfide quantum dots. Optical Material, 78, 113 –117.

Conference Proceedings

1. Roopa Venkataraj, Arindam Sarkar, P Radhakrishnan, M Kailasnath, "Capillary based optical sensor structure for detection of fluoride", National Laser Symposium (NLS-26), BARC, Mumbai, 20-23 Dec (2017)
2. Arindam Sarkar, Roopa Venkataraj, V.P. N Nampoori, M. Kailasnath, "Influence of silver nanoparticles on hollow polymer optical fiber resonator", National Laser Symposium (NLS-26), BARC, Mumbai, 20-23 Dec (2017)
3. Sam Mathew, Haresh S. U, Priyamvada.V.C, P. Radhakrishnan, "Effects of flaxseed powder on the emission characteristics of Rhodamine 6G dye", National Laser Symposium (NLS-26), BARC, Mumbai (2017).
4. Priyamvada.V.C V C, Ajina C, P. Radhakrishnan, "Unclad length dependent performance of silver coated surface Plasmon resonance waveguide as a chemical concentration sensor", Swadeshi Sastra Congress (2017)
5. Sony U, Mathew S, Vijesh K R, V.P.N Nampoori, Sheenu Thomas," Lifetime studies of Styryl 7 dye on different solvents", 27th Swadeshi Science Congress. Amrita Vishwa Vidyapeetham, Amrita University, Kollam (2017)
6. V R Anand, S Mathew, C L Linslal, Jaison Peter, P. Radhakrishnan, M. Kailasnath "Temperature induced tuning of whispering gallery mode laser emission from dye doped polymer fiber", National Laser Symposium (NLS-26), BARC, Mumbai, 20-23 Dec (2017)
7. Ajina C, Fathima Shabana M.A, Krishnendu P.S, Sheenu Thomas, "Silica nano-spheres prepared by modified Stober process for colloidal crystal growth", *AIP Conference Proceedings* 1849, 020041 (2017)
8. Ramya .M, Nideep T.K, V. P. N. Nampoori, M. Kailasnath," Photocatalytic activity of ZnO nanoparticles", IONS, ISP,11-14 Sep (2017).
9. Nideep T.K, Ramya M, M. Kailasnath, ""Photo luminescent studies on water soluble CdTe nanoparticles synthesized using Microwave irradiation", National Laser Symposium (NLS-26), BARC, Mumbai, 20-23 Dec (2017).
10. Fathima R, Regeena I, A. Mujeeb, Ajeena R "Influence of citric acid as an inhibitor on the growth of kidney stone crystals." RTACR S N college Kollam (2017)
11. Vijesh K R, Sony U, V P N Nampoori, and Sheenu Thomas, "*Absolute Fluorescence Quantum yield of Carbon quantum dots using dual beam thermal lens technique"*, IONS-Kochi, September 11-14th (2017)
12. Vijesh K R, Sony U, V P N Nampoori and Sheenu Thomas, "*Studies of thermal and optical properties of carbon quantum dots in DNA matrix"*, National Laser Symposium (NLS-26), BARC, Mumbai, 20-23 Dec (2017)
13. Rehna P Ummer, "Photocatalytic and antibacterial studies of BiFeO3-NaNbO3 composites" 27th Swadeshi Science Congress at Amrita School of Engineering, Kollam, Kerala 7-9 November (2017)
14. V. Anupama, C Ajina, Musfir P.N, and Sheenu Thomas, "Effects of Silver Doping on Optical and Thermal Properties of Ge-Se-Sb Chalcogenide glasses". DAE- BRNS NLS-26 Proceedings (2017)
15. Kalle Koskinen, Abdallah Slablab, Sasi Divya, Robert Czaplicki, Semen Chervinskii, Madanan Kailasnath, Padmanabhan Radhakrishnan, and Martti Kauranen," Bulk second-harmonic generation from thermally evaporated indium selenide thin films", Optics Letters, Vol 42. No. 6 (2017).
16. M.M. Raj Sha, S. Mathew, S. Udayan, A. Ishaq, V.P.N Nampoori, A. Mujeeb "Thermo-Optical studies of CuInGaSe nanocrystals using laser-induced mode-matched thermal lens technique", DAE- BRNS NLS-26 Proceedings (2017)
17. Anitha Prakash, Bini P Pathrose, Vijesh K R, P Radhakrishnan, A Mujeeb. "Measurement of thermal diffusivity of neutral red dye using dual beam thermal lens technique". DAE- BRNS NLS-26 Proceedings (2017)
18. P N Musfir, Sheenu Thomas "Dielectric and AC Conductivity studies in quaternary GeGaSbS Chalcogenide glass thin film" NSCGA-2018, Sacred Heart College, tirupatture, Tamil Nadu, Jan 29-31,2018.

Cherishing Moments….

Industrial visit

Proud Moments for Cusatians

Researchers day out

Onam celebrations

IONS program

Cultural Programs

Kerala Science Congress Curtain Raiser Program

Farewell to final years

XMas celebration

Ifthar Meet

Director's Renovated Cabin

Invited Talk by Dr. P Susthitha Menon

Honouring the winner

Interaction with Shilpi Guptha, IITK

Gratitude to services

Ragging : An Awareness Class

ഫോട്ടോണിക്സ്: ഭാവിയുടെ പ്രകാശം

ISP in the news

Talk on renewable energy sources

CSIR officials at ISP

Interaction with CPW Engineers

Building Extension

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