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Pg 24-27

MADE IN INDIA

India's Indigenously Developed Microscope

Pg 30-36

CREATING REVOLUTIONARY NANO-BLENDED MATERIALS

Pg 48

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7th BANGALORE INDIA NANO SPECIAL

Pg 56-57

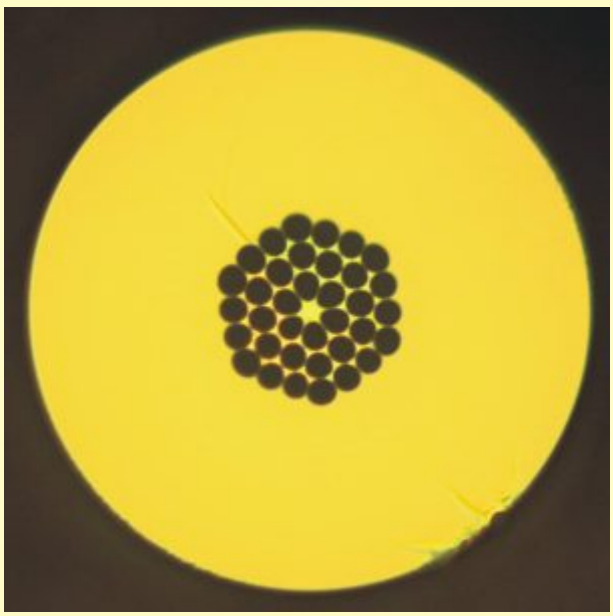
History, Innovation & Evolution of Microscopy Traced"

India's Indigenously Developed Microscope

Even as the country is going gaga over the concept of Make-in-India, here is major scientific achievement by Kolkata's CGCRI in association with a private company based in Thiruvananthapuram Vinvish Technologies Pvt Ltd. These two have joined hands under public-private-partnership to come up with India's indigenously developed microscope, the important success story from CSIR-NMITLI. Nano Digest looks into this wonderful innovation and traces the technology and effort behind the scenes.

In what could termed as a major breakthrough in Indian scientific scenario especially manufacturing of products, a CSIR lab and a private company have joined hands to develop country's first indigenous and cost-effective confocal microscope which promises to provide three dimensional images and will be playing a vital role in scientific understanding of nano-materials and biological objects.

The microscope is a joint public-private partnership effort of the Central Glass and Ceramic Research Institute, Kolkata (CSIR-CGCRI) - a research institute of Centre for Scientific and Industrial Research - and



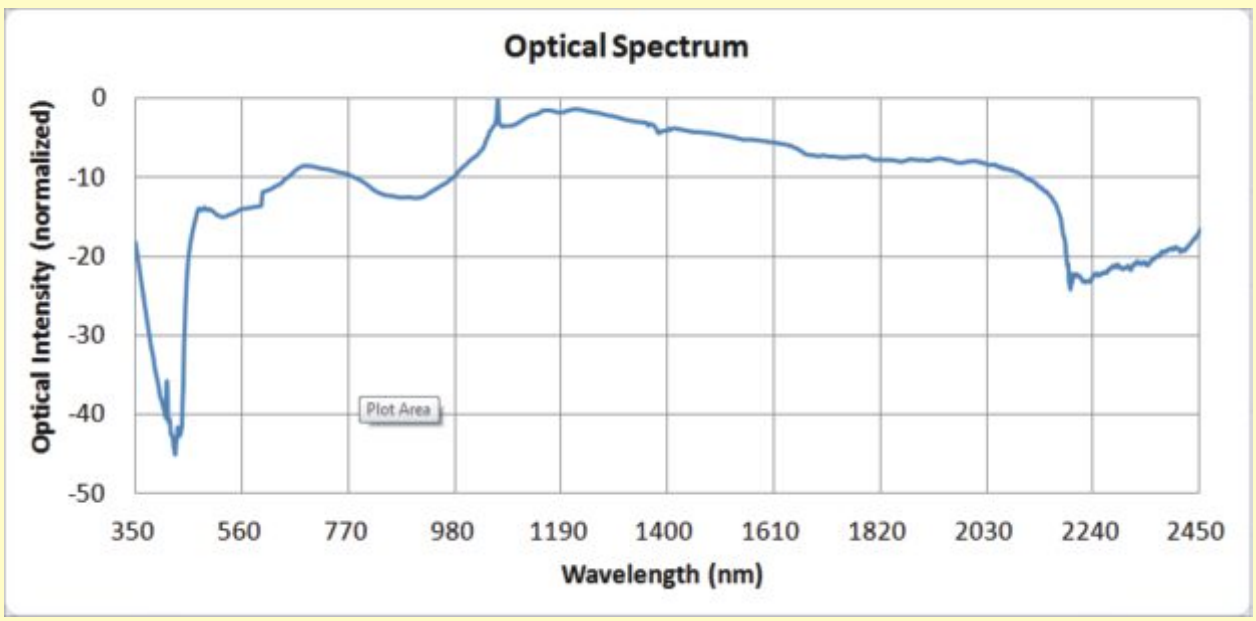
Unlike conventional microscopes which give two dimensional images, the confocal microscope will enable to come up with 3D images. At present, these are only available at limited number of science laboratories in India due to their prohibitive cost. This new innovation is likely to break the cost barrier. They plan to sell it for Rs 1.5 crore while at present, price of a confocal microscope is around Rs. 4 crore.

Background

Lasers have high spatial coherence and very high brightness, which enables optimum coupling to an optical fiber and provides outstanding single-mode beam quality. On the other hand, Supercontinuum light generation is the process of creating pure white light by focusing intense laser pulse into a nonlinear medium. Incandescent and fluorescent lamps, such as those made from tungsten halogens or xenon, provide spectrum of limited width, typically 400 nm to 1,700 nm and this incoherent light is limited to the filament or the gas excitation. Specially designed nonlinear photonic crystal fiber (PCF) has been developed by CSIR-CGCRI, which gives broadband supercontinuum light at the output of the fiber.

Dr. Shyamal Kumar Bhadra

Cross-section of



of supercontinuum source for wide range of applications in the fields of industrial, medical, bio-photonics, nano-photonics, imaging etc, to name a few.

Unlike the normal wide band sources like tungsten, xenon, halogen and SLED, with limited power and spectral width, the developed source's wavelength span ranges from 350 nm to over 2450 nm, with higher spectral power density of the order of 0.1mW/nm to 1mW/nm. Coupling an ultrafast laser pulse directly out of an oscillator into a few meters of photonic crystal fiber (PCF) produced more than an octave broad supercontinuum.

Dr. Ramadas Pillai

The developed supercontinuum source with PCF fibers is reliable, affordable and relatively simple to operate. By varying the design parameters, the PCF can be fabricated to have zero dispersion at a given wavelength, thus enabling symphony of various nonlinear processes with soliton formation and dispersive wave generation in a specific length of PCF resulting bright supercontinuum light at the output. Widest spectra are obtained when the pump pulses are launched close to the zero- dispersion of the non-linear PCF.

After perfecting the demonstration unit, final commercial product of supercontinuum light source was launched on September 26, 2013, on the occasion of CSIR Foundation Day.

Product & Applications

The developed product has multiple applications in the field of high density medical imaging and bio-photonics where broadband coherent light sources are used for spectral illumination. Vinvish is now coming up with photonic products in the Indian market. For the requirements for a comprehensive Quality Management System of design, development and manufacturing of medical devices as per ISO 13485:2003 & ISO 9001:2008, the company is certified as per the standards. The CE certification activities of the supercontinuum laser product are being processed. At CSIR-CGCRI best facility of fabrication specialty fibers is available and that is the only R&D laboratory in the country dedicated to fiber optics and photonics.

Prof K Vijay Raghavan was speaking to the newsmen present on the occasion

CSIR, through such efforts, is achieving its objective of affordable technology systematically on one hand and creating for the country global niches on the other.

As an application demonstration, a Confocal Microscope coupled with Supercontinuum Light Source was developed and demonstrated. The required mechanical hardware, optical design and fabrication as well as the firmware were developed. Fine-tuning of the microscope to get the spectral data for wide band of light was generated. Important part of the supercontinuum light is that each segment of the spectrum is almost behaving as laser light. This development of a reflectance confocal microscope with supercontinuum light source operating over a wide range of wavelength has paved the way for India's presence in global photonics research.

A complete confocal system was launched by Dr Jitendra Singh, Minister of Science and Technology and Earth Science in presence of Prof K Vijay Raghavan, Secretary, DSTDBT- DSIR and Dr PS Ahuja, DG, CSIR, Dr Sudeep Kumar, Head-PPD, CSIR, Kamal Dasgupta, Acting Director, CSIR-CGCRI and Dr R Pillai, MD of Vinvish Technologies, on October 7, 2014 at Delhi.

The developed system is expected to serve as a valuable tool to study the spectrum of microscopic material structures with the advantages of:

(i)simultaneous data acquisition from 450 nm to 2400 nm whereas a conventional confocal microscope uses only a few wavelengths; and

(ii) the developed system uses reflective optics so that it is achromatic in the wavelength range of interest. The developed system is a world class product based on the uniqueness of reflectance spectroscopy.

Behind the Scene

The whole NMITLI project related to both the products was led by Dr Shyamal Kumar Bhadra, Chief Scientist, CSIR-CGCRI, Kolkata and Dr Ramadas Pillai, MD, Vinvish Technologies, Trivandrum.

Others who played an important through their support and guidance for this product development also deserve a mention. Prof Ajoy Ghatak, Chairman, Project Monitoring Committee, Prof Indranil Manna, Chairman, Steering Committee and Director-IIT-Kanpur, Dr Hari Om Yadav, Principal Scientist-CSIR and Coordinator of the Project and Dr K Suresh Nair, Adviser, Vinvish. ■