**Report on the Lecture series**

**Under Erudite: Scholar-in-Residence Programme**

**Kerala State Higher Education Council, Government of Kerala**

By

**Prof. Biju Vasudevan Pillai**

*Professor, Research Institute for Electronic Science & Director, Promotion Office of International Alliance, Hokkaido University, Japan*

18.09.2017 – 28.09.2017

Seminar Hall, Department of Applied Chemistry

Cochin University of Science and Technology (CUSAT)

The major highlight of the lecture series was on Luminescence Spectroscopy and its applications in particularly in the domain of single molecule spectroscopy. This is one f the frontier areas of research where observation of one particular molecule and its dynamics of interaction with the medium or in a domain where it has a specific function to perform. A typical spectroscopic measurement yield only information of a collection of molecules and provide only indications of their action or a particular property. In single molecule spectroscopy one can specifically observe molecules at a particular location in a matrix. The major application of this technique is in the understanding of how a molecule of specific bioactivity such as a drug, a toxin or a specific enzyme or a protein interact or participate in a biochemical event. This can be a specific transport of such biologically important molecule in an event such as targeted drug delivery, cell multiplication mutations etc. A thorough understanding of such molecular dynamics is important in the design of effective drugs and also helps in targeted drug delivery. Recent advances in the area of nano-technology has lead to the invention of several bioactive nanomaterials. Some of them are luminescent and have been used in the luminescent microscopic techniques in life science research. A major problem faced by their use is the blinking phenomena of the nano particles limiting their ability to observe them under single molecule detection scenarios. Prof. Biju a pioneer in understanding the mechanisms of blinking phenomenal and has devised methods to arrest it under experimental conditions. His lectures were planned such a way that they covered very fundamentals of optical spectroscopy in particular luminescence spectroscopy. He opened his lecture series by giving foundations in absorption and emission spectroscopy, its instrumentation used for steady – state detection of absorption and emission. Some of the topics covered were phonon coupling, carrier cooling, delayed fluorescence, phosphorescence, singlet oxygen luminescence, chemiluminescence etc. Any spectroscopic study leading to the understanding of molecular dynamics should be carried out in a a time – resolved manner. The lectures progressed with introduction to time resolved absorption and emission measurements and explained in detail the instrumentation used for various time resolutions ranging from microseconds to femto seconds. Being an expert who has constructed single molecule spectrometer by himself the lecture motivated students and faculty to practice the same in their research. His lecture titled “**Single Molecule Microscopy and Spectroscopy”** heintroduced the concept of single molecule bio-imaging to understand the biological cell structures. The use of Quantum dots for bioimaging technique was discussed in detail covering their synthesis, devices based on QDs and their future prospects. He has demonstrated how they are superior to organic dyes or fluorescent. In order for efficient use in bioimaging, QDs should be made as bioconjugates. The lecture higlighted various strategies of QD – biomolecule conjugation.

The session titled “**Quantum Confinement and Density of States”** was for educating the research students and post – graduate students on the fundamentals of quantum confinement and how it affects the electronic energy levels in nano structures. The mathematical derivation for density of states in one, two and three dimensions were presented to make the students understand the concept. The lecture concluded with methods for tailoring the band gap in materials assemblies such as heterojunctions, multiquantum wells for lasers etc.

A session was dedicated for the **application of nanomaterials in biomedical technology** and gave highlights of some of the technology developments in this area of research.

To conclude the lecture series in the application nanomaterials in various technological domains he gave a detailed lecture on potential toxicological effects to man and nature by these materials. **Nanotoxicity** was discussed in depth and students and faculty were appraised of the precaution to be taken while getting engaged in the study and device fabrications using nanomaterials.

Besides discussion of hard science he has lead sessions on research methodology, data analysis and interpretation and publishing. A detailed lecture was given on how editors and reviewers evaluate research articles. The highlight of the lecture was how academic societies and professional publishing houses influence public funded scientific research. This session was highly informative for the research scholars. A session was also dedicated for planning of research, submission of research proposals and on securing grants. He has also made a short presentation on higher education opportunities for Indian students in Japan and other East Asian countries.

Finally he has delivered a popular lecture on Environmental Footprint. The main highlight of the lecture was the evolution of the universe and where we are heading to.

Prof . Biju Vasudevan Pillai was also visited Feroke College, Kozhikode and delivered a lecture on single molecule spectroscopy and nano technology.

Overall his stay and interaction with the students and faculty was highly motivating and prompted the department to initiate future collaborations in the domain of physical chemistry and nano technology.