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Session II: Sensors

Design of fluorescent molecular probes for various applications

Prof. A. K. Singh

Dept. of Chemistry, IIT Bombay

Prof. earned his PhD from IIT Kanpur in 1978. After post-doctoral stints at Florida State University, University of Hawaii, and Columbia University he returned to India in 1982 to join University of Roorkee as a lecturer in chemistry. In January 1983, he moved to IIT Bombay as Lecturer in Chemistry and subsequently rose to the rank of full Professor in 1990. He spent a year as visiting scientist at the University of Montreal, Canada in 1989. Currently he is with IIT Bombay as the Highest Academic Grade Professor in the Department of Chemistry.



Prof. Singh has served several academic and research organizations, government bodies, and scientific societies at the highest management and governance levels. At IIT Bombay he was Head of the Department of Chemistry, Convener of Post-Graduate Academic Performance Evaluation, Chairman of IIT-JEE, and Dean of Academic Program. He was Convener of IIT Gandhinagar Cell and Director of CSIR-Regional Research Laboratory, Jorhat. He served two major Universities – Bundelkhand University and University of Allahabad as Vice Chancellor.

Prof. Singh has been a mentor to a large number of graduate and undergraduate students. He has authored numerous research papers and scholarly articles in reputed journals. His research interests span the areas of organic and bioorganic chemistry, natural products, bio-molecular chemistry, medicinal chemistry, photochemistry and photobiology and nanoscience. He has richly contributed to the understanding of structure and mechanism of function of retinal-based biological photoreceptors, particularly bacteriorhodopsin and photocontrol of structure and reactivity of organic and bioorganic systems. He has also contributed towards the design of fluorescence probes, organic reactions in organized assemblies, phototriggers for biomolecular caging, design and synthesis of antiradical compounds, radioprotectants, vitamin A analogues, excited state chemistry of linear polyenes, novel photochemical routes to heterocycles, and the design and development of organic nanoparticles of biomedical and opto-electronic significance.

Prof. Singh is one of the most highly honoured and recognized academician in India. He is an elected Fellow of the National Academy of Sciences-India and Indian Academy of Sciences and the Royal Society of Chemistry, U.K. He is recipient of Prof. P. K. Bose Memorial Award (1999) and Prof. J. N. Mukherjee Memorial Award – 2009 from the Indian Chemical Society; and, the 'Award for Excellence in Chemical Sciences – 2009' from the Indian Society of Chemists and Biologists.

Abstract

Fluorescent sensors and reporter find numerous applications in biological and medical sciences and technology. Consequently, a large number of fluorescent compounds, both synthetic as well as of biological nature have been developed for various applications. Research and innovation, particularly employing nanoscience and technology concepts have further enlarged the pool of such fluorescent molecular systems, and opened new areas of applications. In particular, fluorescent probes based on small organic molecules are used extensively in fluorescent and colorimetric detection, in vitro diagnostics, in vivo imaging, biomolecular labels, stains, and in many other applications. Photochromics, optical-memory and optical switches, solvatochromics in biological probes and medical applications are also the subject of much contemporary interest.

We have been interested in de novo design and synthesis of fluorescent probes from small organic molecules for different biological, biomedical and opto-electronic applications. Our efforts have yielded fluorescent probes based on α,ω -diaryl-polyenes and styrylindoles. These molecules can undergo conformationally relaxed intramolecular charge transfer and exhibit solvatochromic dual emission, and can be used as reporters of polarity and microenvironment of organized assemblies and proteins. Crystals of some of these compounds have also been found to exhibit enhanced emission. Further, we have designed fluorescent organic nanoparticles (FONs) of styrylindoles capable of exhibiting aggregation-induced enhanced emission. This presentation, while focusing on our efforts towards de novo design, properties and applications of fluorescent probes, will also review recent accomplishments in the field and highlight future research and innovation possibilities.