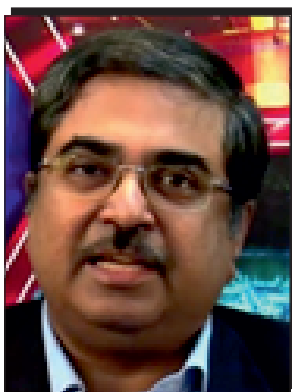


Session IV: Functional Colorants

Excited State Processes in Colorants of Today and Tomorrow



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Prof. Datta completed his M.Sc. in Physical Chemistry from Calcutta University in 1994 and earned his PhD from Indian Association for the Cultivation of Science in 1998. After a post-doctoral stint at Iowa State University he returned to India in 2000 to join Raja Ramanna Centre for Advanced Technology, Indore. In 2002, he moved to IIT Bombay as Assistant Professor and subsequently rose to the rank of full Professor in 2012. He was Associate Dean (Student Affairs) from 2016 to 2018 and has been Head of the Department of Chemistry since 2018.

Prof. Datta has received awards from IIT-Bombay both for research and teaching. Chemical Research Society of India awarded him a Bronze Medal in 2018. He was elected into the National Academy of Sciences as a Fellow in 2017. Prof. Datta has published 113 papers in peer-reviewed journals. He has guided 15 Ph.D. students and 43 M.Sc. students.

Abstract

Our group studies excited state processes in molecules and materials. We have recently begun collaborative exploratory studies in biological systems. This presentation focuses on fluorogenic molecules that are inherently non-fluorescent or weakly fluorescent, but become strongly emissive as a result of chemical reaction or solidification. These molecules can be potentially applied in the fields of fluorescence sensing and organic electronics. Salophen, a fluorogenic Schiff base, exhibits an increase in its fluorescence quantum yield and lifetime upon complexation. This enhancement, which is significantly more in its monomeric Al^{3+} complex than in its dimeric Zn^{2+} complex (SalZn), is ascribed to the blocking of nonradiative channels associated with flexing motion of the molecule. Uncomplexed salophen exhibits the same phenomenon in the solid state or by incorporating it in a solid matrix like polymethylmethacrylate (PMMA). Such enhancement of emission is also observed in the case of SalZn. Interestingly, a quenching of fluorescence is observed in the crystals of SalAl³⁺. These apparently conflicting trends can be attributed to the molecular arrangement of salophen and its complexes in a solid matrix and in the pure solid forms. X-ray crystal structure of SalAl³⁺ indicates the possibility of π - π interaction between the planar ligands of two neighboring complex molecules leading to aggregation-caused quenching (ACQ). This provides a justification for the lower emissivity of dimeric SalZn, as compared to monomeric SalAl³⁺ in solution. In case of salophen, solidification is not associated with π - π interaction and so, aggregation induced enhancement of emission (AIEE) is observed. Thus, the emissivity of salophen and its complexes is found to be governed by the interplay of torsional motion and intermolecular interaction. Manipulation of these factors has been attempted by synthetic modification. Introduction of alkoxy groups in salophen ring is found to alter not only the photophysics, but also molecular packing of the molecules in their crystals, leading to a higher emissivity of the Al^{3+} complexes in their crystalline form.