Selective and sensitive detection of acraldehyde in a mixture of aliphatic aldehydes using N and S - doped carbon dots as a unique fluorescent probe

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Abstract: Acraldehyde (Acrolein, CH_2=CHCHO) a colourless liquid with a piercing, acrid smell, is a toxic and highly reactive α,β-unsaturated aldehyde widely disseminated in air and water as a common pollutant that ispredominantly generated endogenically through lipoxidation reactions in food and biological systems. Over time, acrolein polymerizes to form a hard, porous plastic in water in presence of oxygen when present at concentrations above 22%. In biological systems, it reacts with the nucleophilic sites of proteinsto form covalently modified biomolecules which are perceived as pathogenic factors in the onset and progression of many pathological disorders such as skin, respiratory, cardiovascular and neurodegenerative diseases and its permissible exposure limit has been set at 0.1 ppm[1]. Thus, it is relevant to have a simple and rapid technique for detection and high-throughput screening of acrolein in mixtures of aldehydes in water samples.

The present work attempts to make a contribution in this direction, wherein nitrogen and sulphur co-doped carbon dots (NSCDs) have been utilized to serve as a unique fluorescent probe for the detection of acraldehyde (acrolein) in a mixture of aliphatic aldehydes. The NSCDs were synthesized by a simple one-pot microwave assisted pyrolysis technique using citric acid as the source of carbon and thiourea as the source of nitrogen and sulphur. The as-prepared NSCDs have been characterized and have been found to show a narrow distribution in size, excellent aqueous solubility and excitation wavelength dependent emission behaviour with high quantum yield (12 %). Compared to other aldehydes, the fluorescence intensity of NSCDs was found to undergo significantly quenched in presence of acrolein and the decreased intensity was found to be linearly proportional to the concentration of acrolein in the range of 0 – 16 µM with a detection limit of 6.30 µM. The TCSPC studies confirmed that the quenching process is static in nature. The proposed sensing technique can be proposed as a prospective platform for selective and sensitive detection of acrolein in relevant test samples.

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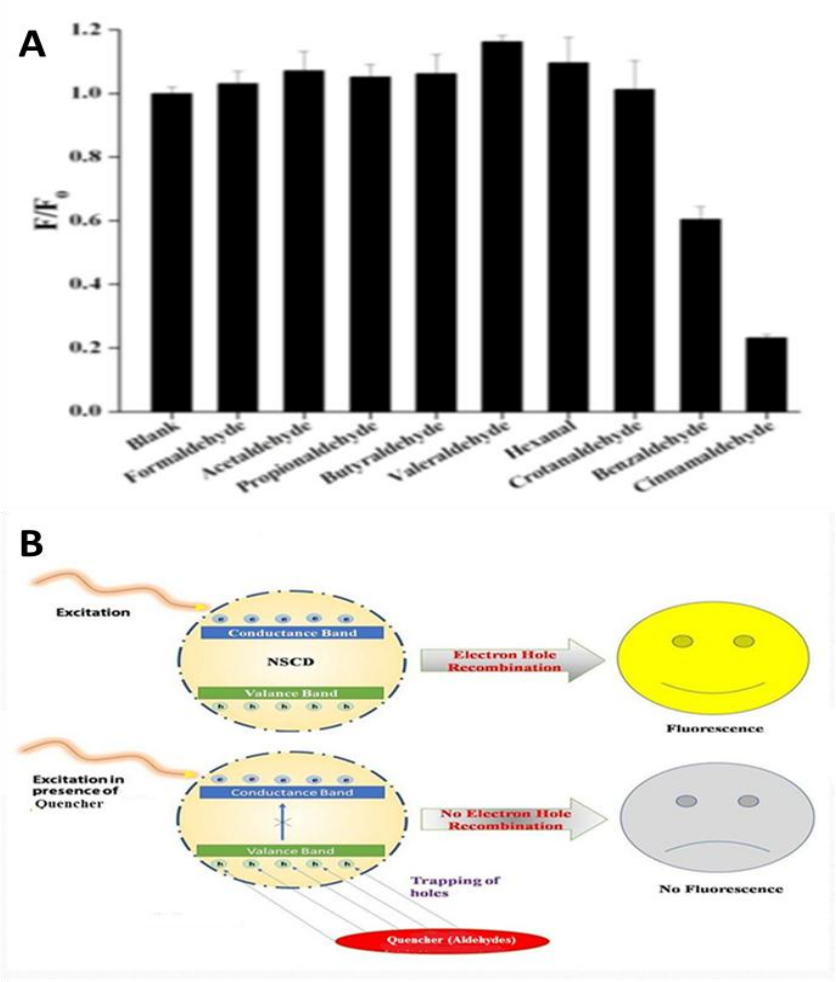

Figure : (A) Comparison of fluorescence intensities of NSCDs after addition of different aldehydes in the same concentration (B) Schematic diagram of plausible mechanism

Biography: Manisha Shaw received her B.Sc. degree from University of Calcutta, India and M.Sc. degree from department of chemistry, Indian Institute of technology, Kharagpur, India. She presently is a PhD student in department of chemistry, Indian Institute of technology, Kharagpur.

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