N-doped carbon dot as fluorescent probe for detection of cysteamine and multicolor cell imaging

Dipanjan Samanta, Suraj Konar and Amita Pathak*

Department of Chemistry, Indian Institute of Technology, Kharagpur, West Bengal, 721302, India

Abstract: Cysteamine, an aminothiol compound, is perhaps the only therapeutic molecule known for the treatment of *cystinosis* [1], which is a genetic disease characterized by abnormal accumulation of the amino acid, cysteine, within the lysosomes and then eventually gets crystallized/deposited in the vital organs such as – kidney, liver, spleen, cornea *etc*. Cysteamine is known to suppress the deposition of cysteine in lysosome by penetrating through the lysosomal membrane and rupturing the S–S bonds between cysteine molecules in the deposit and in the process producing free cysteine and cysteine–cysteamine disulfide that gets eliminated through lysine porters [2]. Cysteamine is also recognized for its neuroprotective ability and can function to preserve the neuronal structure and/or function in animal cells. Besides, the thiol functionality in cysteamine assists its oxidizing ability and enhances its potency as an antioxidant [3] In the present work, we developed nitrogen-doped carbon dots (NCDs) as novel fluorescence probe for the quantitative detection of cysteamine. NCDs were synthesized by a rapid one-pot microwave assisted pyrolysis method using tartaric acid as the source of carbon and urea as N-dopant. The synthesized NCDs possessed multicolor (blue, green and red) fluorescence and excitation wavelength dependent emission behaviour. It was found that the fluorescence intensity of NCDs was quenched with the addition of cysteamine which may be attributed to the formation of non-fluorescent ground state complex. Under optimum condition, the linear response was observed in the range of 10-210 µM and the detection limit was found to be 75.6 nM for sensing the cysteamine.

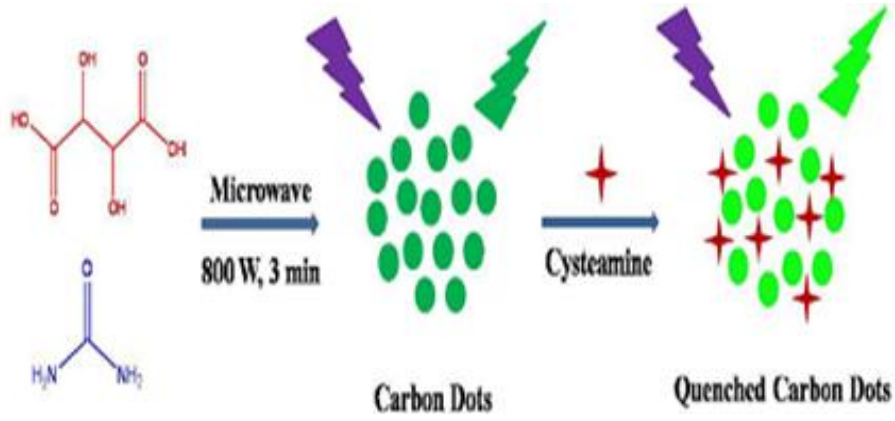

Figure 1: Modes of detection of cysteamine by fluorescent Carbon Dots.

Moreover, the proposed sensing methodology showed high selectivity for cysteamine over a number of interfering metal ions and amino acids. The remarkable biocompatibility of NCDs was investigated in MDA-MB-231 breast cancer cells which impacts its immense potential for diagnostic purposes. The proposed sensing method is thus simple with high sensitivity and excellent selectivity. We expect that this method will become a potential tool for the detection of cysteamine in biological samples.

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