Morphology dependent antioxidant property of CuO nanostructures

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Abstract: Application of number of metal / metal oxide nanoparticles in biology is symptomatic of a revolution in the field of healthcare (e.g., diagnostic or therapeutic) and in the different biomedical practices. To exploit the benefits rationally it is relevant to understand the biological response to the unique physico-chemical and architectural features of the metal / metal oxide nanoparticles and also to design and establish easy and sensitive techniques to assess and validate these responses. The present study is an endeavor in this direction where, the focus is on investigating the variation in antioxidant (i.e., the radical scavenging) property of copper oxide (CuO) nanostructures with change in their morphology. Herein, we also put forward a simple and effective methodology for estimating the antioxidant property associated with the different morphologies of CuO nanostructures through photoluminescence studies where nitrogen and sulphur doped carbon dots (NSCDs) have been introduced as a unique and biocompatible, fluorescent probe. The investigation involved ligand-regulated growth of rod-, spherical-, star-, and flower-shaped morphologies of the CuO nanostructures through an aqueous-based chemical precipitation route where the Cu^{2+} ions were stabilized through complexation with different carboxylic acids (viz. acetic/citric/tartaric acid).

The *in vitro*antioxidant activity of the different morphologies of CuO nanostructures was appraised through: (i) DPPH free radical scavenging assay were the color change in and (ii) fluorescent quenching studies with NSCDs as the fluorescent probe and the interpretations were validated through EPR studies. The nano rod-shaped CuO nanostructures, by virtue of their of their high negative surface charge potential (at the experimental pH of 7); large accessible surface due to absence of any chelating ligand attached to the Cu^{+2} ion; and low adsorption potential due to lower BET surface area were to show the highest free radical scavenging ability and recognized as better antioxidants compared to those of the other CuO morphologies. The present study also endorsed the NSCDs as a novel probe for fluorescence based assay in the assessing the antioxidant behaviour of CuO through electron-hole recombination mechanism that followed the static fluorescence quenching process.

Reference:

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5th International Conference on Nanotechnology for Better Living (NBL-2019), Jointly organized by National Institute of Technology (NIT) Srinagar and Indian Institute of Technology (IIT) Kharagpur; April 7 – 11, 2019 at SKUAST, Shalimar Srinagar, Jammu and Kashmir, India; Editor: Dr. M. A. Shah and Prof. P. Banerji, ISBN:978-81-939516-0-6; Published by Applied Science Innovations Pvt. Ltd., Pune, Maharashtra, India.