Abstract

Applications of Synthesized Copper and Iron Based Nanomaterials in Water Pollution and in Biological Fields

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Drinking water pollution through heavy metals, organic phenolic components is an alarming issue worldwide and various indiscriminate anthropological activities, expansion of population and fast pace in industrialization are the root causes of this global quandary leading to major threat to the various biotic and abiotic components of the ecosystem. Alongside improper management in remediating these pollutants culminate in the growth of microorganisms and biofouling. There had been various attempts first of all to devise a good detecting system of heavy metals and materials for removing the organic pollutants as well as the microorganisms that are stamped as the crucial foes of the aqueous habitat. Of all the popular conventional detecting techniques available, fluorescent sensors are now been regarded as the first choice for tracing out heavy metals in water for their efficiency in terms of selectivity and high-end sensitivity. Besides, to address the organic pollutant removal and decontaminating the water environment from the yoke of microorganisms there is urgent need for a suitable material which should serve the salient parameters of being biologically compatible with no burdens of toxicity, quick availability where the material can be synthesized easily and lastly being economically feasible. This research work centralize around transition metals like copper and iron nanomaterials that serves functions of detecting heavy metals, remediating organic materials and microorganisms. Iron oxyhroxide (α-FeOOH) nanomaterials are been selected to aid in detection of heavy metal ion, hexavalent Chromium (VI)- a model heavy metal ion chosen to study the pattern of detection when the α-FeOOH nanomaterial is decorated with nitrogenous carbon dot. The aggregation of carbon dot is being thwarted by the biocompatible iron oxyhydroxide nanomaterial that acts as a matrix. With an excellent sensing ability this nano-sensor was equally capable in their performance as a biosensor. In this work, the biosensing mechanism was evaluated through *in vitro*

sensing of Cr (VI) in HeLa cells. Additionally copper based semiconductor chalcogenide, copper sulphide (CuS) nanoparticles are chosen to eliminate a potent carcinogen in waste water, para-nitrophenol (*p*NP) by converting the product to para-amino phenol (*p*AP) through catalytic reduction using sodium borohydride ($NaBH_4$). CuS nanoparticles were capped with a biocompatible block copolymer Pluronic F-127 and this nanomaterial served dual functions of not only eliminating the waste pollutant but showed excellent antimicrobial activity against a faecal coliform *Eschericia coli* (*Escherichia coli* ATCC 25922) and biofilm forming *Staphylococcus aureus* (*Staphylococcus aureus* ATCC 25923). The synthesized chalcogenide nanoparticles also showed marked antioxidant activity and cytocompatibility when haemolysis assay was performed. The mentioned transition nanoparticles were subjected through various characterization techniques and thus have been proved to be excellent candidates as nanosensors, nanocatalyst and nano-bio-remediators of the aqueous system with additional qualities of performing as a biosensor and a nanodrug.

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