CURCUMIN ANCHORED ZINC OXIDE NANOFLOWERS: A NOVEL COMPOSITE NANOMATERIAL FOR ENHANCED PHOTOCATALYTIC AND ANTIMICROBIAL ACTIVITY

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Abstract

ZnO nanoparticles are widely used in many applications such as anti-microbial activity, anti-oxidant activity and photo-catalytic activity. However, the application of ZnO becomes limited, specifically when the activation of the nanoparticles is achieved via electromagnetic radiation, as the response of ZnO is greatly limited to ultraviolet wavelengths. A common strategy that has been commonly adapted to overcome this limitation is to functionalize the nanoparticle surface with photo-responsive agents that would amplify the photo-activity of ZnO nanoparticles. This strategy has been reported in recent studies and it has allowed modest improvements in the intrinsic properties of ZnO. It is intuitive to believe that the enhancement in the properties is proportional to the degree of surface functionalization. Hence, the challenge in hand is to devise novel nanostructures of ZnO with an increased surface area by increased levels of functionalization with a given photo-responsive agent.

Hence, the focus of this study was to synthesize a ZnO nanomaterial with an increased degree of surface functionalization. Accordingly, ZnO nanoflowers were synthesized using a facile and fast synthesis method at 50 °C using $Zn(NO_3)_2.6H_2O$ and NaOH. Scanning electron microscopic analysis showed that the ZnO nanoflowers consist ZnO nanosheets with a thickness of approximately 85 ± 20 nm, leading to nanoflowers with a diameter of approximately 1996 ± 400 nm, which effectively creates nanoscale crevices into which molecules may travel, thereby effectively amplifying the surface area available for molecular level functionalization.

Curcumin (diferuloylmethane) is a polyphenol derived from Curcuma longa plant, commonly known as turmeric. It possesses anti-microbial, anti-cancer, and antioxidant activities. Hence, here curcumin anchored ZnO nanoflowers were successfully synthesized. The functionalization of curcumin here was conducted by a facile solution-phase anchoring from a freshly prepared ethanolic curcumin solution on an as-purified sample of ZnO nanoparticles. It was observed that the novel nanostructures indicate coverage of approximately 2000 ppm of curcumin, resulting from the increased surface area available for functionalization.

The photocatalytic activity of curcumin anchored ZnO nanoflowers was studied at their different concentrations by measuring the rate of methylene blue degradation under UV irradiation and visible light irradiation. It was proven by anchoring curcumin on ZnO, enhance the photocatalytic activity of ZnO nanoflowers.

Curcumin anchored ZnO nanoflowers have shown promising antibacterial activity and antifungal activity compared to the naked ZnO nanoparticles and curcumin.