GOLD NANOPARTICLE GRAFTED ZnO NANOFLOWERS: ENHANCING THE NANOSCALE ACTIVITY THROUGH OPTIMAL SURFACE FUNCTIONALIZATION

By

K.G.N.S.WEERASINGHE

(214858797)

Thesis submitted as a partial requirement for the

B.Sc Special Degree in Chemistry

Department of Chemistry

Faculty of Natural Sciences

Open University of Sri Lanka

November - 2020

ABSTRACT

ZnO nanoparticles have received much attention due to their unique physical and chemical properties. Nevertheless, it is notable that the applicability of ZnO is limited as it is photoresponsive only within the ultraviolet wavelength range of the electromagnetic spectrum. To overcome this limitation, often the surface of the nanoparticle is functionalized with a photo-responsive agent which amplifies the photo-activity of ZnO nanoparticles. As a consequence, ZnO nanoparticles may begin to exhibit photo-activity in both UV and visible wavelengths.

As expected, this effect is more pronounced when the degree of functionalization on the nanoparticles is higher. Hence it has become essential to explore the possibility to produce nanoparticles of various morphologies where the surface area available for functionalization is greater, leading to notable enhancements in photoresponse. As a consequence ZnO nanoflowers were synthesized where the petal-shaped nanosheets are combined together to form a flower-shaped morphology.

Hence, the research question here was to investigate whether it is possible to synthesize a novel composite with synergistically enhanced photocatalytic and antimicrobial properties, with the anchoring of a suitable photo–responsive agent onto ZnO nanoflowers through surface functionalization. Accordingly, gold nanoparticles well known to produce modest intensification of nanoscale properties upon functionalization on a given material, were selected as the anchoring agent.

Zinc nitrate hexahydrate and sodium hydroxide were used as main precursors in the synthesis of flower shaped ZnO nanoparticles. The well-known Turkevich method was used for the synthesis of gold nanoparticles.

The SEM technique was used to investigate the morphology and size of the ZnO nanoparticles. The SEM images clearly reveal the flower-shaped morphology of the synthesized nanoparticles. The average thickness of a nanosheet was found to be 68.6 ± 0.5 nm whereas the average diameter of a nanoflower is 1600 ± 3.7 nm.

Antibacterial activity of nanoparticles were evaluated using the drop diffusion method while disc diffusion method was performed on the same plate for the positive control. Photocatalytic properties were studied under UV and visible light.