MODELING THE PHOTOCATALYTIC AND ANTIMICROBIAL ACTIVITIES OF ZnO BY CHOOSING THE ALCOHOL TYPE IN THE SYNTHESIS

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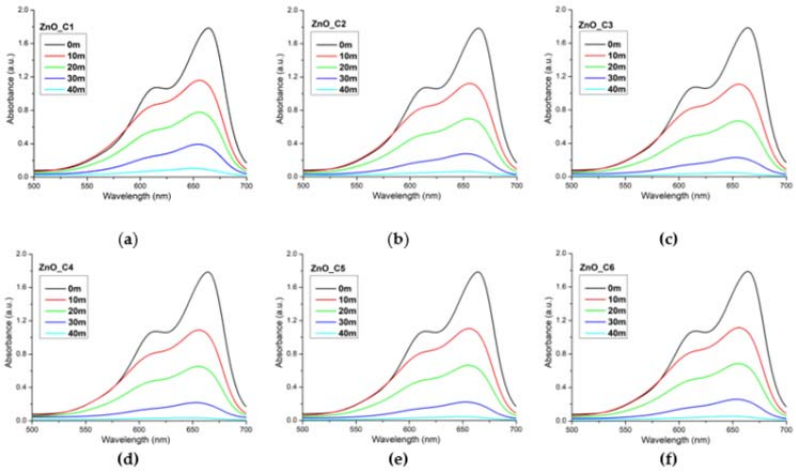
Zinc oxide (ZnO) is one of the most important nanomaterials, which is used in various health-related applications, from antimicrobial textiles to wound dressing composites and from sunscreens to antimicrobial packaging. Purity, surface defects, size and morphology of the nanoparticles are the main factors that influence the antimicrobial properties. In this study we are comparing the properties of the ZnO nanoparticles obtained by solvolysis using a series of alcohols: primary from methanol to 1-hexanol, secondary (2-propanol and 2-butanol) and tertiary (*tert*-butanol). While the synthesis of ZnO nanoparticles is successfully accomplished in all primary alcohols, the use of secondary or tertiary alcohols does not lead to ZnO as final product, underlining the importance of the used solvent. The shape of the obtained nanoparticles depends on the used alcohol, from quasi-spherical to rods, and consequently different properties are reported, including photocatalytic and antimicrobial activities. While the size of the nanoparticles was in the range 34-54 nm, with the lowest dimensions for the 1-butanol synthesis, the shape of the nanoparticles was found to be spherical for methanol, changing to polyhedral up to 1-butanol and becoming rod-like for 1-hexanol.

The highest photocatalytic activity against methylene blue was found for the ZnO obtained in 1-butanol, with a photo-degradation efficiency of 98.24% after 40 min. The comparative study among a series of usual model dyes revealed that triarylmethane dyes are less susceptible to photo-degradation, especially gentian violet and rhodamine B, with an efficiency just above 50%. In the photocatalytic study, the ZnO obtained in 1-butanol exhibited the best performance against methylene blue (MB) dye solution, attaining a degradation efficiency of 98.24%. The obtained ZnO nanoparticles present a strong antimicrobial activity on a broad range of microorganisms (bacterial and fungal strains), the size and shape being the important factors. This permits further tailoring for use in medical applications.



Photocatalytic activity against MB for: (a) ZnO_C1; (b) ZnO_C2; (c) ZnO_C3; (d) ZnO_C4; (e) ZnO_C5; (f) ZnO_C6; (g) detail for all samples after 40 minutes irradiation; (h) the proposed mechanism for photo-degradation of the dye

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