New and efficient phosphor-based visible-light-driven photocatalysts for the removal of antibiotics from the aquatic environment

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1. Introduction – The introduction of pharmaceuticals such as antibiotic agents into the aquatic environment and ecosystems, due to the human activities, was identified as one of the emerging environmental and health issues during the last two decades [1]. Zinc Oxide (ZnO) is one of the most widely used semiconductor photocatalyst in water decontamination. However, ZnO is a wide bandgap material (Eg = 3.37 eV) that can only be activated by ultraviolet (UV) light which represents only about 5% of the sun light [2]. Therefore, the development of new and efficient visible light driven photocatalysts is of critical importance to the worldwide adoption of photocatalytic decontamination technologies. In the present study, we developed a simple, rapid and versatile synthetic method to a large variety of visible light driven nanostructured photocatalysts by the growth of ZnO Nanocrystals (ZnO NCs) on the surface of light converting nanoparticles (also called *nanophosphors*) in a core/shell like structure (Fig. 1). The as-prepared core/shell nanostructured photocatalysts (CS-NSP) were successfully applied, for the first time, for the removal of antibiotics from aqueous solution. The recyclability of the CS-NP was also demonstrated.

2. Experimental – YAG:Ce, LuAG:Ce and LaYSiN:Ce phosphor NPs were used in the present study. Sulfathiazole (STZ) was used as antibiotic. Photocatalytic study was carried out under visible light (Fig. 2).

3. Results and Discussion - Results showed that ZnO NCs of about 10 nm diameter are homogeneously grown on the surface of about 100 nm phosphor NPs in a core/shell-like structure (Fig. 1). The Photocatalytic activity study showed that the photodecomposition rate of STZ is 3 times higher in the presence of nanophosphor/ZnO CS-NSP when compared to the pure ZnO NCs.

4. Conclusions – A simple and rapid sol-gel synthesis method was successfully used to prepare a number of phosphor/ZnO core/shell nanostructure photocatalyst. The as-prepared photocatalysts were found to have a superior photodecomposition rate of STZ under visible light compared to the pure ZnO at the same irradiation time. The photocatalytic recyclability study also showed that nanophosphor/ZnO CS-NSP can be reused in a multiple photocatalytic cycles without compromising the photocatalytic efficiency of the composite. Finally, ZnO NCs and phosphor NPs are chemically stable, low cost and suitable for large-scale production. We believe that phosphors NPs/ZnO CS-NSP will have great interest in the future for both air and water decontamination.

5. References

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