

SYNTHESIS AND CHARACTERIZATION OF NOVEL NANOCOMPOSITE MATERIALS BASED ON PMMA WITH Ag, TiO₂ AND ZnO NANOPARTICLES WITH ANTIMICROBIAL PROPERTIES

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Introduction: Nowadays, conventional polymeric materials such as poly(methyl methacrylate), PMMA, can improve their current properties or even obtain new characteristics as a result of their modification with inorganic nanoparticles (NPs). In recent years, Ag, TiO₂ and ZnO NPs have been studied a lot due to their significant antimicrobial properties.

Methods: In this paper nanocomposites of PMMA with 0.2, 0.5 and 1% w/w silver, titanium oxide and zinc oxide nanoparticles were successfully prepared by an in situ radical polymerization technique. The reduction of Ag⁺ took place during the reaction. A big variety of techniques such as thermogravimetric analysis (TGA), gel permeation chromatography (GPC), differential scanning calorimetry (DSC) were used in order to investigate the properties of pure PMMA and PMMA/nanoparticles composites.

Results: It was observed that the presence of the nanoparticles leads to the reduction of the reaction rate but it increases the number average molecular weight of polymer nanocomposites. The glass transition temperature was found to decrease with the amount of Ag and ZnO NPs but the converse happened in the case of PMMA/TiO₂ NPs. The polydispersity of the MWD was lower in PMMA/ nanoparticles composites than those of pure PMMA. In order to confirm the presence of NPs in the final product we used X-Ray diffraction, horizontal Attenuated total reflection (HATR-FTIR) and ultraviolet-visible spectroscopy (UV-Vis). Moreover, thermogravimetric analysis showed that the presence of NPs enhance the thermal stability of the nanocomposites. Finally, the antimicrobial properties of the nanocomposites were studied against bacterial strains of E.Coli and St.Aureus using pure PMMA as control agent.

Conclusions: Nanocomposites of PMMA with several NPs were successfully synthesized and they showed improved properties compared to neat PMMA.