

Multifunctional Plasmonic Ag-TiO₂ Nano-biocomposites: Surface Enhanced Raman Scattering and Anti-microbial Properties

Authors : Jai Prakash, Promod Kumar, Chantel Swart, J. H. Neethling, A. Janse van Vuuren, H. C. Swart

Abstract : Ag nanoparticles (NPs) have been used as functional nanomaterials due to their optical and antibacterial properties. Similarly, TiO₂ photocatalysts have also been used as suitable nanomaterials for killing cancer cells, viruses and bacteria. Here, we report on multifunctional plasmonic Ag-TiO₂ nano-biocomposite synthesized by the sol-gel technique and their optical, surface enhanced Raman scattering (SERS) and antibacterial activities. The as-prepared composites of Ag-TiO₂ with different silver content and TiO₂ nanopowder were characterized by X-ray diffraction, scanning electron microscopy, high-resolution transmission electron microscopy, energy-dispersed X-ray analysis (EDX), UV-vis and Raman spectroscopy. The Ag NPs were found to be uniformly distributed and strongly attached to the TiO₂ matrix. The novel optical response of the Ag-TiO₂ nanocomposites is due to the strong electric field from the surface plasmon excitation of the Ag NPs. The Raman spectrum of Ag-TiO₂ nanocomposite was found to be enhanced as compared to TiO₂. The enhancement of the low frequency band is evident. This indicates the SERS effect of the TiO₂ NPs in close vicinity of Ag NPs. In addition, nanocomposites showed enhancement in the SERS signals of methyl orange (MO) dye molecules with increasing Ag content. The localized electromagnetic field from the surface plasmon excitation of the Ag NPs was responsible for the SERS signals of the TiO₂ NPs and MO molecules. The antimicrobial effect of the Ag-TiO₂ nanocomposites with different silver content and TiO₂ nanopowder were carried out against the bacterium *Staphylococcus aureus*. The Ag-TiO₂ composites showed antibacterial activity towards *S. aureus* with increasing Ag content as compared to the TiO₂ nanopowder. These results foresee promising applications of the functional plasmonic metal-semiconductor based nanobiocomposites for both chemical and biological samples.

Keywords : metal-Semiconductor, nano-Biocomposites, anti-microbial activity, surface enhanced Raman scattering

Conference Title : ICAMN 2015 : International Conference on Advanced Materials and Nanotechnology

Conference Location : Bangkok, Thailand

Conference Dates : December 17-18, 2015