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

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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
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