Tip-Enhanced Raman Imaging of Plasmon-Driven Coupling of 4-Nitrobenzenethiol on Au-Decorated Magnesium Nanostructures

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Magnesium nanoparticles (MgNPs) exhibit localized surface plasmon resonances across the ultraviolet, visible, and near-infrared parts of electromagnetic spectrum and are attracting increasing interest due to their sustainability and biocompatibility. In this study, we used tip-enhanced Raman spectroscopy (TERS) to examine the photocatalytic properties of MgNP protected by a thin native oxide layer and their Au-modified bimetallic analogs produced by partial galvanic replacement, AuMgNPs. We found no reduction of 4-nitrobenzenethiol (4-NBT) to p,p-dimercaptoazobisbenzene (DMAB) when a Au-coated tip was placed in contact with a self-assembled monolayer of 4-NBT molecules adsorbed on MgNPs alone. However, decorating Mg with Au made these bimetallic structures catalytically active. The DMAB signal signature of photocatalytic activity was more delocalized around AuNPs attached to Mg than around AuNPs on a Si substrate, indicating coupling between the Mg core and Au decorations. This report on photocatalytic activity of a bimetallic structure including plasmonic Mg paves the way for further catalyst architectures benefiting from Mg's versatility and abundance.