Plasmonic Identification of Microorganisms via Nanoparticle-induced Interfacial Accumulation

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Preconcentration of microorganisms dispersed in water is essential in identification of microbial species which can provide significant benefits in many areas such as treatment of infectious diseases or pathogen inspection. A standard method for this purpose is conventional cell culture. However, this process is time-consuming since it typically takes 1-3 days. Moreover, further 1-2 days are required to identify their species by other sophisticated tools (e.g., PCR). Here, we propose a rapid identification of microbial species based on surface-enhanced Raman spectroscopy (SERS) by nanoparticle-induced preconcentration of microorganisms at air/water interface. Our method is based on interesting finding that electrostatically-attached gold nanoparticles on cell surfaces can increase their hydrophobicity, thereby causing irreversible adhesion and preconcentration at the interface to reduce interfacial energy. Using our method, characteristic Raman transitions of various microorganisms can be identified. Interfacial adhesion of microorganisms and assembly behavior of nanoparticles are systematically investigated by dark-field microscope and scanning electron microscope (SEM).