Plasmons in atomscale and nanoscale objects: Physics and applications

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Surface plasmon polaritons and its low-dimensional variants as well as their confined standing waves (antenna resonances) have become increasingly important in nanotechnology since their optical properties are strongly dependent on the size and the shape of the small objects. This perfectly fits to the directions of nanotechnology which is to provide appropriate building blocks to embody nano-architecture with desired functions for novel electronics/photonics devices. Even down to the subnanometer-scale thin objects plasmon propagation was detected recently and revealed a rich diversity of physics. On the other hand, antenna resonaces in closed structures (nanoparticles, nanowires, nanodisks) strongly coulple with light and exhibit wide variety of applications in the field of nanophotonics, environmental science, and light harvesting technology. In this talk I present some fundamental aspects of realizing plasmonic resonators with both narrow-band and broad-band optical response, and then introduce some applications in photocatalysis as well as bio/environmental sensing with excellent specificity and extremely high sensitivity (< attomolar sensitivity) in aqueous solution.