Triggering and monitoring plasmon enhanced reactions by optical nanoantennas coupled to photocatalytic beads

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ABSTRACT

Plasmonic metal/semiconductor nanocomposites promise to be a breakthrough for boosting and investigating photon-assisted processes at the nanoscale, with exciting perspectives for energy conversion and catalysis. However, efficiency and selectivity of these surface processes are still far from being controlled. Here we show for the first time a new class of photocatalyst which is based on the synergistic combination of bowtie-like gold nanoantennas and SiO_2/TiO_2 core/shell oxide beads. These systems were exploited as efficient near-field optical light concentrators, stimulating photon-driven processes at the metal-semiconductor interface. Extraordinary enhancements of photodegradation rates (minutes instead of hours) resulted by matching the nanoantenna surface plasmon resonance with the optical absorption of organic dyes and the excitation source wavelength. Moreover, strong Raman enhancements were observed allowing for direct in-situ monitoring of reaction progress of different analytes on the same site.