Hot-spots in Plasmonic Photocatalysis

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Abstract

Herein, we introduce a novel approach for achieving a real-time control over the hot-electron injection process in metal-semiconductor photocatalysts. Such functionality is attained through the design of a hybrid nanocomposite in which plasmonic Au nanorods and TiO2 nanoparticles are synergistically integrated with a thermoresponsive polymer. In this manner, modifying the temperature of the system allows for (i) the precise regulation of the interparticle distance between the catalyst and the plasmonic component, and (ii) the reversible formation of plasmonic hot spots on the semiconductor. Both features can be simultaneously exploited to modulate the injection of hot electrons, thus boosting/inhibiting at will the photocatalytic activity of these heterostructures. This innovative conception enables a dynamically adjustable performance of semiconductors, hence opening the door to the development of a new generation of plasmon-operated photocatalytic devices.

Figures

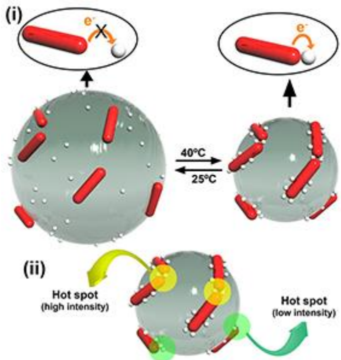

Figure 1: Representation of the collapse-swelling transition experienced by the Au-TiO2/pNIPAM nanohybrids leading to, (i) the control of the electron injection on TiO2 by tuning the interparticle distance between the semiconductor and the plasmonic material, and (ii) the reversible formation of interparticle hot spots.