Plasmon-enhanced molecular sensing and photocatalyst for green nanotechnology

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One of the most scientifically as well as technologically interesting phenomena in metal nano-objects is, antenna resonace in closed structure (nanoparticles, nanowires, lithographic structrure) which makes the nano-object strongly coulpled with light. The phenomena exhibits wide variety of applications in the field of nanophotonics, environmental science, and light harvesting technology, by utilising its strong electromagnetic field-enhancement, light absorption/emission associated with the antenna resonances of these metal nanostructures. 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 plasmon-enhanced oxide photocatalysis as well as bio/environmental sensing with excellent specificity and extremely high sensitivity (< attomolar sensitivity) in aqueous solution. We introduce our recent study on the metal nanoparticle-loaded zinc-oxide photocatalyst with increased photocatalytic activity in the visible spectral region. We also report the detection of mercuric ion in environmental water by monitoring the conformational change and the relevant changes in the vibrational signal induced by the absorption of toxicants in bio-molecules.

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References

[1] Tadaaki Nagao et al. Sci. Technol. Adv. Mater. 11 (2010) 054506.

[2] Nanoantenna: Plasmon-Enhanced Spectroscopies for Biotechnological Applications Edited by M.L. Chapelle, A. Pucci (Pan Stanford Series on the High-Tech of Biotechnology, 2013).

[3] Chung V. Hoang, et al., Scientific Reports 3 (2013)1175. doi:10.1038/srep01175

Figures

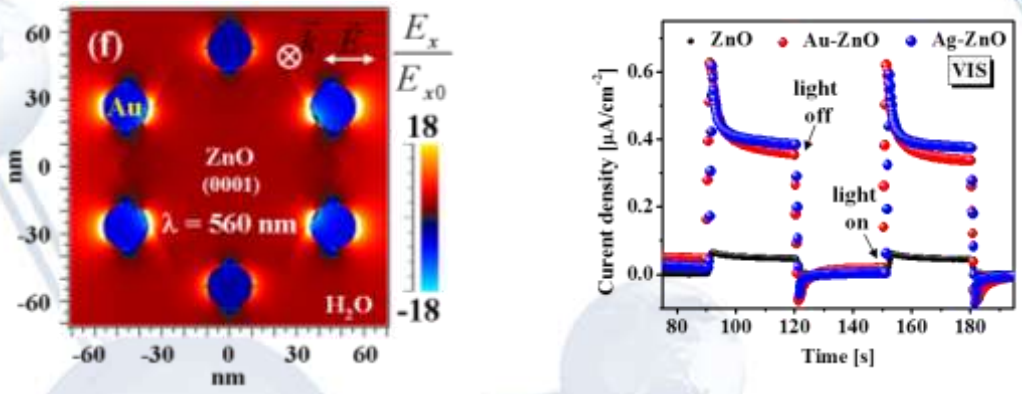

Figure 1: An example for a numerical simulation of the electric field distribution of metal nanoparticle-loaded ZnO nanowire (left) and photocurrent associated with visible light illumination of the fabricated photocatalyst. Dramatic increase in the photocurrent with the visible light illumination is generated after the loading of metal nanoparticles (right).