Noble Metal-based Nanostructured Catalysts for Hydrogenation and Dehydrogenation Reactions via Plasmon-assisted Catalysis

([1]*Graduate School of Engineering, Osaka University*, [2]*ESICB, Kyoto University,* [3]*JST PRESTO*) ○Priyanka Verma,[1] Yasutaka Kuwahara,[1,2,3] Kohsuke Mori,[1,2] Hiromi Yamashita[1,2]
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The plasmonic metal nanoparticles (NPs) interact with the incoming photons to create significant absorption and scattering cross-sections leading to unique chemical and physical properties. The interaction and oscillation of electrons creates a strong electromagnetic field around the metal NP when irradiated at the resonant frequency of light. In the last decade, plasmonic catalysts have been widely researched for their characterization and application in diverse chemical reactions under visible light irradiation conditions.[1]

In our recent research report, a combination of Ag NPs with single site Ti-oxide moiety (Ag/Ti-SBA-15) was developed to link together Vis-active plasmonic and UV-active single site photocatalysts for the enhanced hydrogen production activity from ammonia borane (AB) under UV-vis light irradiation.[1] The X-ray absorption near edge structure spectroscopy confirmed the existence of Ti-oxide single-site species in a highly dispersed manner. A reaction rate of 3.3 μmol min^{-1} was obtained under UV-vis light irradiation which was twice to the Ag/SBA-15 catalyst. Furthermore, plasmonic Ag NPs prepared by following a similar synthesis strategy on metal oxide support materials, for example, CeO_2/SBA-15 and bare commercial metal oxide supports (TiO_2, Al_2O_3 and ZrO_2) displayed active performance in the chemoselective reduction of *p*-nitrostyrene (*p*-NS) to *p*-aminostyrene (*p*-AS) utilizing AB as an *in-situ* source of hydrogen.[2] The superior chemoselective performance in the formation of *p*-AS was obtained when green LED light was irradiated during the reaction (**Figure 1**).

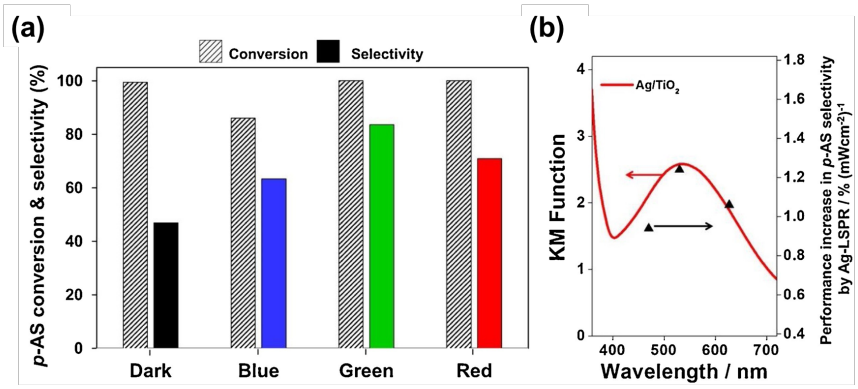

Figure 1. (a) Effect of different wavelengths of LED over Ag/TiO_2; (b) Action spectrum of Ag/TiO_2.

1) P. Verma, K. Mori, Y. Kuwahara, R. Raja, H. Yamashita, *Mater. Adv.*, **2021**, 2, 880-906. 2) P. Verma, Y. Kuwahara, K. Mori, H. Yamashita, *Catal. Today*, **2019**, 324, 83-89.