Electronic Supplementary information (ESI) for

Plasmonic Cooperation Effect of Metal Nanomaterials at Au-TiO₂-Ag Interface to Enhance Photovoltaic Performance for Dye Sensitized Solar Cells

Yang Wang⁵, Jin Zhai⁶* and Yanlin Song⁶*⁷

a Key Laboratory of Bio-Inspired Smart Interfacial Science and Technology of Ministry of Education, School of Chemistry and Environment, Beihang University, Beijing 100191, China.
b Institute of Chemistry Chinese Academy of Sciences, 100190, Beijing, (P. R. China).
TiO$_2$ / (Au, Ag or Au and Ag) films were characterized by XRD analyses to judge the presence of metal nanoparticles. Fig. S1 showed the XRD patterns of FTO glass (a), FTO/TiO$_2$ film (b), FTO/TiO$_2$/Au film (c), FTO/TiO$_2$/Ag film (d) and FTO/Au/TiO$_2$/Ag film (e) without N719 dye. Comparing with the XRD curves of films, all films showed anatase phases belonged to TiO$_2$. However, it could not detect the diffraction of Au and Ag species. The result might be caused by the low amount of Au or Ag anchored on TiO$_2$ films.
The image of the electrodes is shown in inset figure S2a (from left to right: TiO₂ (white), Au-TiO₂ (purple) and Au-TiO₂-Ag (brown)). Figure S2a is the SEM cross section view of Au-TiO₂-Ag electrode. The thickness of Au-TiO₂-Ag electrode is ~10 μm. Figure S2b is the SEM enlargement image of Au-TiO₂-Ag electrode. White ring represents the TiO₂. Red ring represents the Au or Ag nanomaterials. We differentiate the difference between TiO₂ and metal nanomaterials through the size of nanoparticles. The diameter of TiO₂ is ~20 nm (TiO₂ was characterized by XRD analyses, as shown in figure S1). The diameter of Au or Ag is ~60 nm (the presence of Au and Ag was judged by XPS, as shown in figure 3). Each of Au or Ag nanomaterials is surrounded by TiO₂. Therefore, the Au-TiO₂-Ag interface is existed.
Plasmonic cooperation effect of Au and Ag were characterized by UV-vis absorption. Figure S2 showed the UV-vis absorption spectra of Au nanoparticles (black), Ag nanoparticles (red) and Au-Ag nanoparticles (blue). The position of Au nanoparticles and Ag nanoparticles absorption peak were 538 nm and 415 nm, respectively. When Au and Ag nanoparticles were mixed, the broadening phenomenon centered in 475 nm was happened, which was caused by plasmonic cooperation effect of Au and Ag.