Supporting information

$Sn_xTi_{1-x}O_2$ Solid-solution-nanoparticle Embedded Mesoporous Silica (SBA-15) Hybrid as an Engineered Photocatalyst with Enhanced Activity

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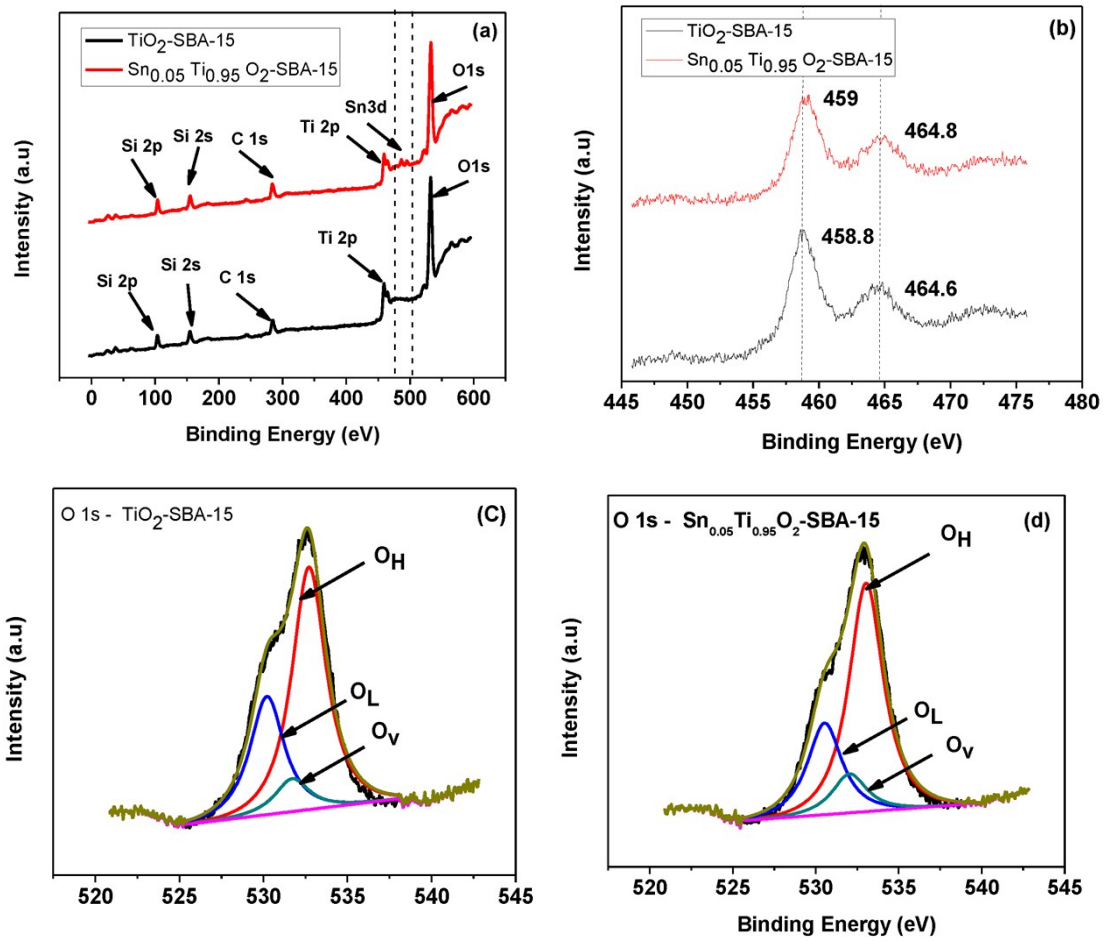

Fig. S1 XPS spectra of $Sn_{0.05}Ti_{0.95}O_{2-}$ sphere-like SBA-15 and TiO_2- sphere-like SBA-15 (a) complete survey; (b) Ti 2P; (c) and (d) O1s.

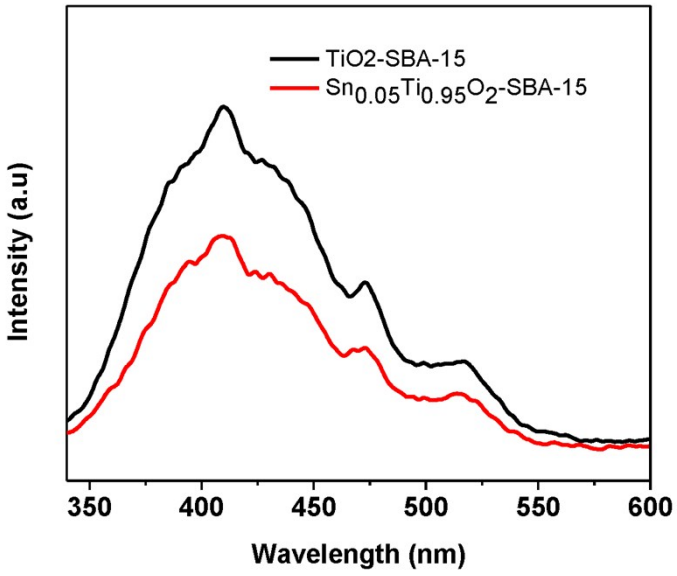

Fig. S2 Photoluminescence spectra of $Sn_{0.05}Ti_{0.95}O_{2-}$ sphere-like SBA-15 and TiO_2- sphere-like SBA-15.

Fig. S1 shows the XPS spectra of $Sn_{0.05}Ti_{0.95}$ O_2 - sphere-like SBA-15 and TiO_2-sphere-like SBA-15 particles. There is a positive shift (Fig S1b) in Ti2p peak of $Sn_{0.05}Ti_{0.95}O_2$-sphere-like SBA-15 in comparison to TiO_2-Sphere-like SBA-15, which confirms the Ti-O-Sn bond formation. Furthermore, the replacement of Sn^{4+} in Ti^{4+} lattice could lead to the weakening of Ti-O bonds. As a result, oxygen vacancies are created. The percentage of oxygen vacancy increased for $Sn_{0.05}Ti_{0.95}O_2$- sphere-like SBA-15 (to 10.85 %), as compared to TiO_2- sphere-like SBA-15 (only 8.35%). It can be clearly seen from Fig. (c) and (d), where the peak area of oxygen vacancies at 531 eV for $Sn_{0.05}Ti_{0.95}O_2$- sphere-like SBA-15 is higher than that of TiO_2- Sphere-like SBA-15. This is also supported by the photoluminescence spectra, shown in Fig. S2, where $Sn_{0.05}Ti_{0.95}O_2$-sphere-like SBA-15 hybrid exhibits a lower PL emission intensity than that of TiO_2- sphere-like SBA-15. Moreover, the peak at around 410 nm is ascribed to the intrinsic state transitions of anatase phase TiO_2. Peaks around 460 nm and 520 nm can correspond to trapped charges and oxygen vacancy. Therefore, the lower PL spectra are mainly attributed to the surface states resulting from the oxygen vacancies and defects on the TiO_2 surface. The oxygen vacancy site in the photocatalyst can trap charge carriers, leading to decrease in recombination of electron-hole pairs. Besides that, presence of hydroxyl species on the catalyst surface also helps in increasing the photocatalytic activity. As a result, the decrease in recombination of charge carriers reduces the intensity of photoluminescence spectra of $Sn_{0.05}Ti_{0.95}$ O_2-sphere-like SBA-15 hybrid. Thus, an improved photocatalytic activity is achieved for $Sn_{0.05}Ti_{0.95}$ O_2-sphere-like SBA-15 hybrid.