High photocatalytic activity of $\text{Zn}_2\text{SnO}_4$ among various structures of $\text{Zn}_{2x}\text{Sn}_{1-x}\text{O}_2$ prepared by a hydrothermal method

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In recent years, heterogeneous photocatalysis has received increasing attention for environmental applications such as air purification, water disinfection, hazardous remediation and water purification [1, 2]. The high photocatalytic degradation of semiconductors, such as $\text{TiO}_2$ and $\text{ZnO}$ has attracted extensive attention of many researchers [3].

In this paper, different structures and morphologies of $\text{SnO}_2$ containing various amounts of $\text{ZnO}$, was synthesized via a hydrothermal method (without any template), characterized by scanning electron microscopy and powder X-ray diffraction, and used for photocatalytic degradation of Congo red. The results revealed that using different ratios of $\text{Zn}^{2+}/\text{Sn}^{2+}$ affects the phase and morphology of the $\text{Zn}_{2x}\text{Sn}_{1-x}\text{O}_2$ compounds (see Fig. 1). This type of morphology tailoring of $\text{SnO}_2$ nanoparticles, $\text{ZnO}$ doped $\text{SnO}_2$ porous structure, $\text{ZnSnO}_3$ flower-like, and $\text{Zn}_2\text{SnO}_4$ octahedrals was possible, by varying the $\text{Zn}^{2+}/\text{Sn}^{2+}$ ratio of 0, 1/10, 1/5 and 1/1, respectively. These products could be formed by decomposition of $\text{ZnSn(OH)}_6$ phase. $\text{Zn}_2\text{SnO}_4$ with octahedral morphology exhibited a significant enhancement of photocatalytic activity toward degrading Congo red, as compared to other samples. This could be attributed to enhanced oxygen vacancies and crystallite defects formed by substitution of $\text{Zn}^{2+}$ in the lattice of $\text{SnO}_2$, revealed in photoluminescence measurements (see Fig. 2).

References

Figures

Fig. 1: Figure 2: SEM images of samples, a) $\text{SnO}_2$ nanoparticles, b) $\text{ZnO}$ doped $\text{SnO}_2$ porous structure, c) $\text{ZnSnO}_3$ flower-like d) $\text{Zn}_2\text{SnO}_4$ octahedral.

Fig. 2: The PL spectra of the samples.