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Development of 2D materials based on SnS_2 doped with RE^{3+} ions for application in heterogenous photocatalysis

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2D materials have attracted significant attention due to their exceptional photocatalytic properties, which are attributed to their unique physical and chemical properties. Among these materials, tin sulfides can be obtained in different phases as SnS, SnS_2, Sn_2S_3, Sn_3S_4, and Sn_4S_5, each exhibiting distinct features [1]. The introduction of the rare earth ions (RE^{3+}) into the lattice can further modify their features and functionality [2]. This work reports a hydrothermal synthesis at 180 °C for 6h of SnS_2 materials with and without Er^{3+}/Yb^{3+}, starting from $SnCl_4.5H_2O$ and thiourea as precursors. From the X-ray diffractogram, XRD (Fig. 1A) and transmission electron microscopy, 2D layered hexagonal SnS_2 nanoflakes was identified, with a space group P63mc (JCPDS no. 43003) and cell parameters set as a=53.645 b=3.645 c=11.802. Annealing the materials results in the formation of tetragonal SnO_2, as confirmed by XRD and Raman spectroscopy (Fig. 1B). Photocatalytic properties were demonstrated by employing blue LED irradiation, showing the removal of up to 86% (Fig. 1C) of the antibiotic tetracycline hydrochloride (THC) through adsorption and degradation processes using a SnS_2 concentration of 1.5 g L^{-1}. Further application will be explored as photocatalytic system driven by upconversion and NIR sensors.

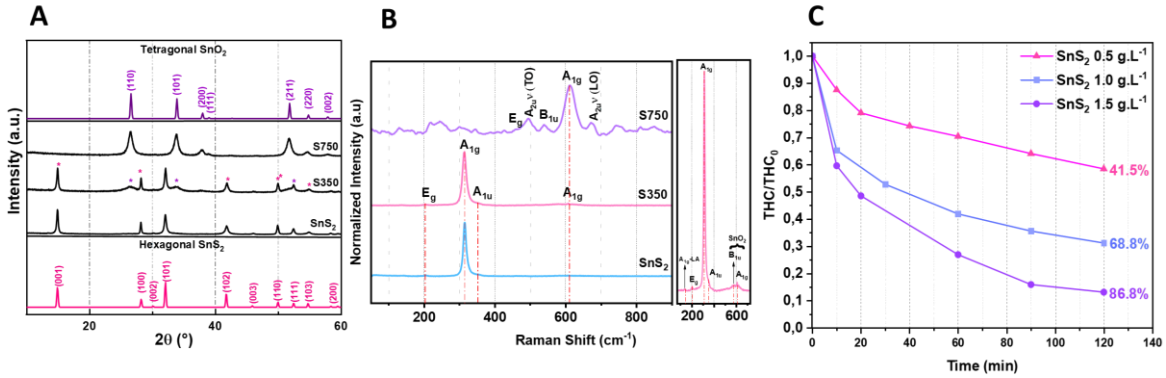

Figure 1. (A) X-ray diffractograms and (B) Raman spectra of the samples SnS_2 without annealed, annealed at 350 and 750 °C; and (C) photocatalysis SnS_2 with different concentrations in the presence H_2O_2 10 mM.

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