Electronic Supplementary Information

for

Ultra-small Sn_2S_3 porous nano-particles: an excellent photo-catalyst in reduction of aqueous Cr(VI) under visible light irradiation

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Experimental setup

In a typical experiment, 2.2g thioacetamide (TAA) were separately added into 10mL of distilled water solutions containing 5 and 10 μL hydrochloric acid (HCl), and 1g hexadecyl trimethyl ammonium Bromide (CTAB) as a dispersing agent, to make a series of solutions by stirring and ultrasonic treatment. A well polished pure (99.99%) Sn plate was placed on the bottom of a rotating glass dish with speed of ~200rpm filled with 3mm depth of liquid solution. A Q-switched Nd-YAG (Yttrium Aluminum Garnet) laser (Quanta Ray, Spectra Physics) beam operating at wavelength of 1064nm with a pulse duration of about 10ns and 10Hz repetition was focused on the Sn target with the average spot size of ~500μm by a quartz lens with 50 mm focal length. The laser beam power density was about 7 GW/cm^2, and the ablation lasted for 30 minutes. The laser power density was adopted to induce effective ablation and yet not too high to cause splashing of the solution layer. After laser fabrication, the products were carefully washed, and centrifuged at 18000 rpm for 15 min by an ultracentrifuge. The sediments were dropped on a copper mesh and dried in an oven at room temperature for observation by transmission electron microscopy (JEOL-JEM-2100F).

Additionally, the crystallographic investigation of the ultra-small nano-particles (dried in an oven at room temperature) were analyzed by X-ray diffraction (XRD) patterns (Rigaku RINT-2500VHF) using Cu Kα radiation (λ =0.15406nm). Morphological investigations were measured by field emission scanning electron microscope (SEM, Hitachi, S-4800).

Photo-catalytic- reduction of Cr(VI)

Photo-catalytic-reduction of Cr(VI) under visible-light irradiation using 15W lamp with about 50 lm/w, and wavelength of 400~750nm. The reaction vessel was placed in a sealed black box with the top opened and lamp was placed to provide visible-light irradiation. In a typical process, 9~120mg of the photo-catalyst were separately added into 50 ~300mL of $K_2Cr_2O_7$ solution with concentration varying from 10~300mg/L, and then exposed to visible-light irradiation for certain time. Because of the superior photo-catalytic activity of Sn_2S_3 nano-particles, it should be noted that photo-catalytic-experiments in this work were not stirred under the dark condition to reach adsorption equilibrium between the catalyst and the solution, which is different from the common photo-catalytic reductions.[1-4] At the end of reduction, the photo-catalysts were removed from the solution by centrifuged at 18000 rpm for 15 min at given time intervals (1min). The Cr(VI) concentrations were measured by the absorbance spectrums of Cr(VI) solution, which were carried by a UV-Vis-IR spectrometer (UV-1800, Shimadzu).

REFFRENCES:

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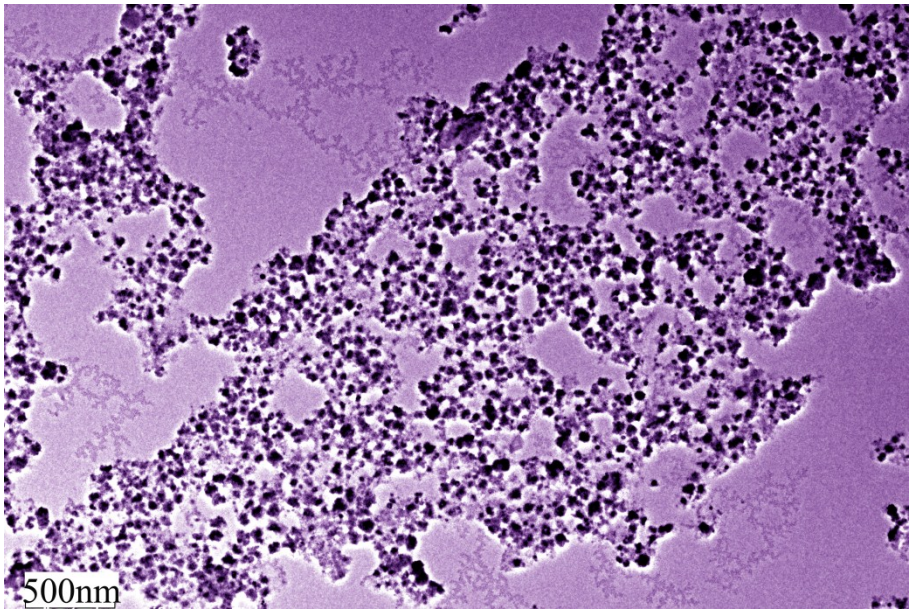

Fig. S1 The low magnification TEM image of the nano-particles by laser ablation of Sn target in activated liquid containing 5μl HCl.

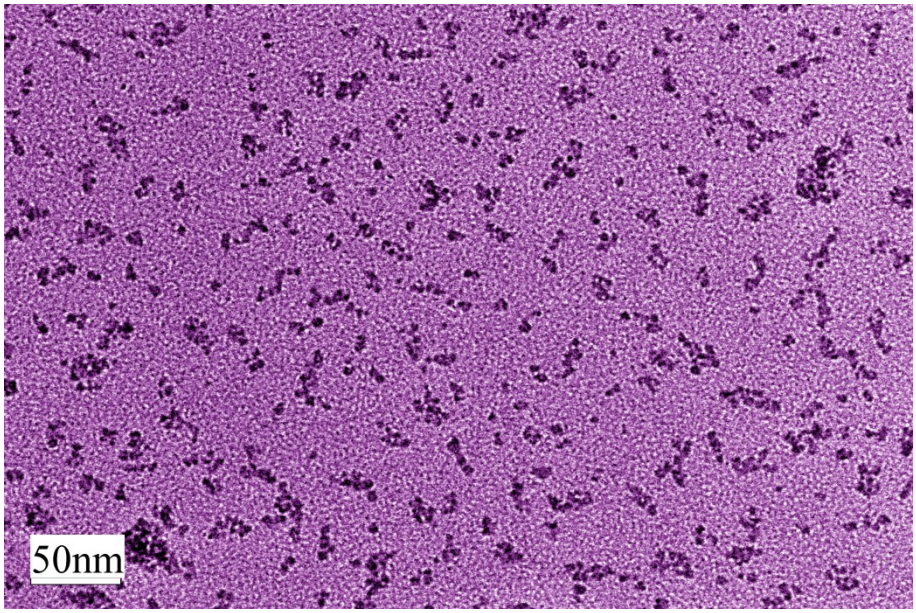

Fig. S2 The low magnification TEM image of the ultra-small nano-particles by laser ablation of Sn target in activated solution containing 10μl HCl.

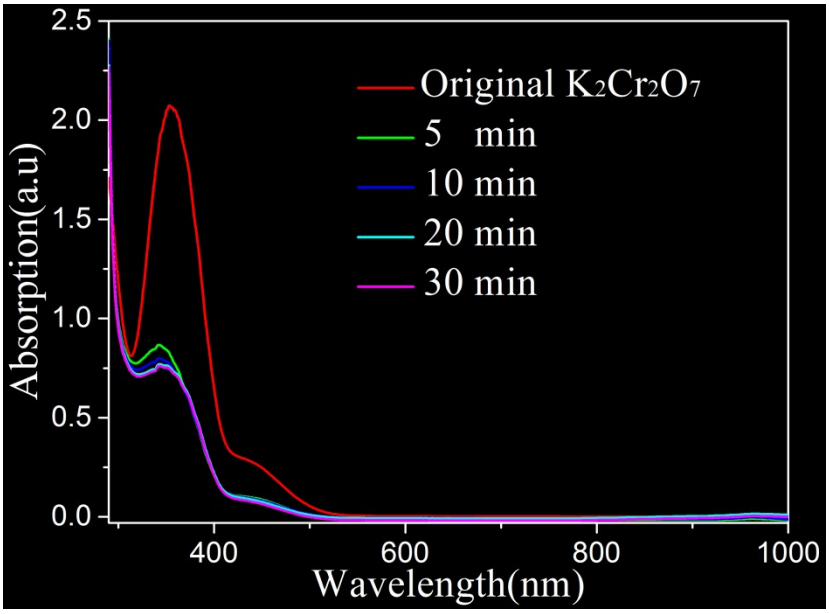

Fig. S3 Photocatalytic reduction of 50mL of 1×10^{-3} M aqueous Cr(VI) without any HCl in solution under visible light irradiation in the presence of large sized Sn_2S_3 nano-particles

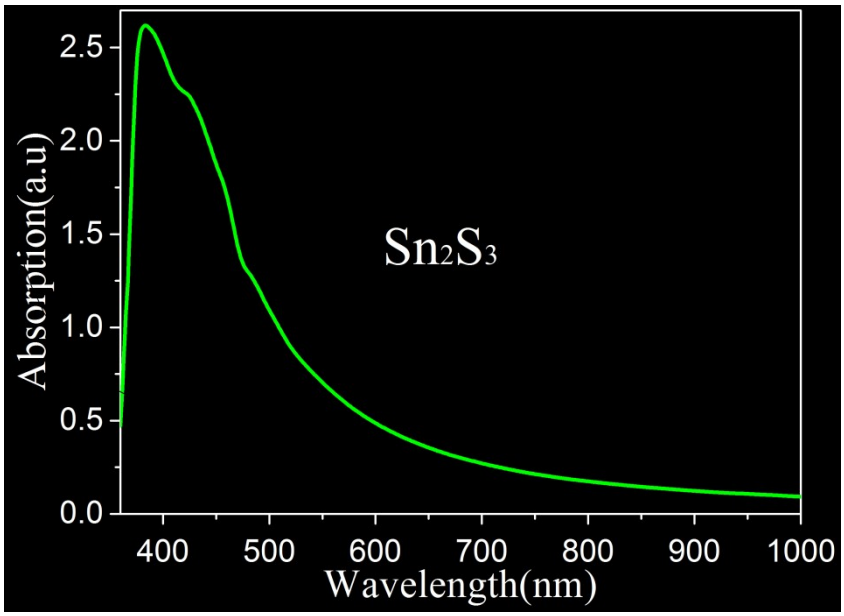

Fig. S4 The UV-visible absorption spectrum of the as-prepared ultra-small Sn_2S_3 porous nano-particles

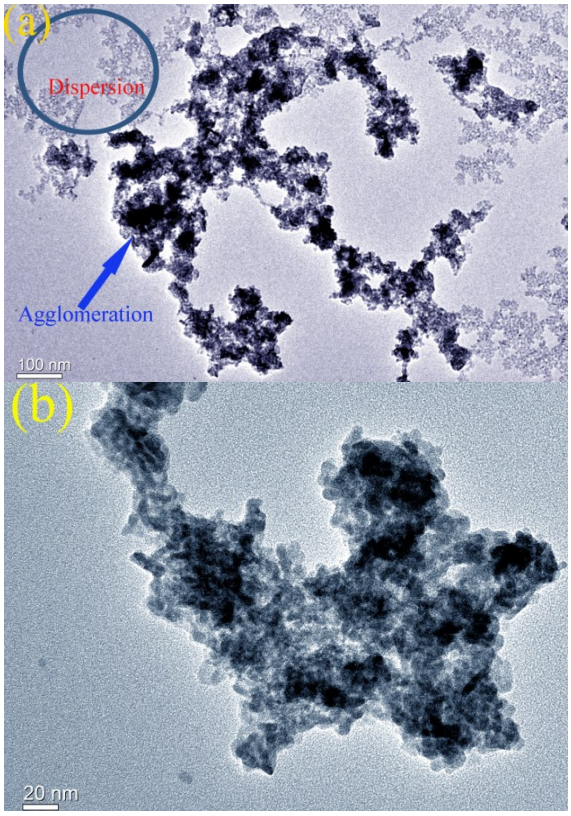

Fig. S5 The representative low-and enlarge magnification TEM images of ultra-small Sn_2S_3 porous nano-particles with high concentration of 120 mg/300mL. In addition to the well-dispersed structure, the catalysts are re-combination and agglomeration in the TEM image.