

Supplementary Information

**Reactive and Photocatalytic Degradation of Various Water Contaminants by
Laser Ablation-derived SnO_x Nanoparticles in Liquid**

Zhenfei Tian, Changhao Liang,^{*} Jun Liu, Hemin Zhang and Lide Zhang

Key Laboratory of Materials Physics and Anhui Key Laboratory of Nanomaterials
and Nanotechnology, Institute of Solid State Physics,
Hefei Institutes of Physical Science, Chinese Academy of Sciences
Hefei 230031, China

* Corresponding author. Tel.: +86 551 5591129; fax: +86 551 5591434.

E-mail address: chliang@issp.ac.cn (C. H. Liang).

Figure S1 reveals the position variation of peak at the center of 242 nm in degradation of MO using primary SnO_x nanoparticles. The peak will not disappear unless the light illuminated process was employed. If we interrupted the degradation process and put the solution in the dark for a span (for example, 3 days), the peak will shift to around 250 nm. When UV light illuminated further, this peak will disappear gradually. It is evident that using primary SnO_x nanoparticles for MO degradation, unstable intermediate product generated. The intermediate product was reported as a hydrazine derivative, which usually generates in MO photoreduction. In a word, it also proved that the MO was really decomposed rather than simple surface adsorption removal.

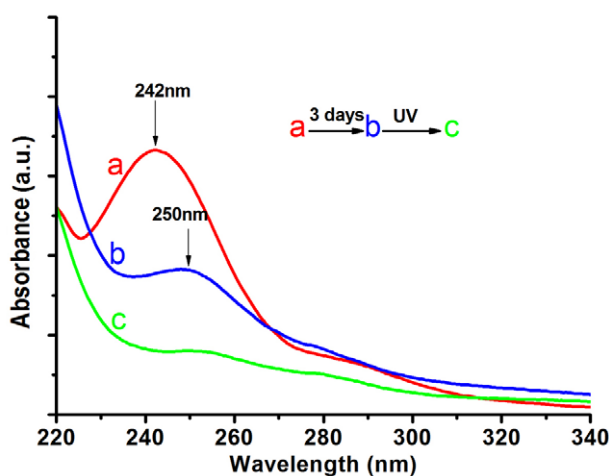


Fig. S1 UV spectra of methyl orange degradation: (a) in degradation; (b) ageing in the dark for three days; (c) further degradation under the UV light.

Figure S2 gives the EDS analysis and surface elements mapping of primary SnO_x after reduction of hexavalent chromium Cr (VI). We found that part of element Cr was homogeneously distributed onto SnO_x nanoparticles.

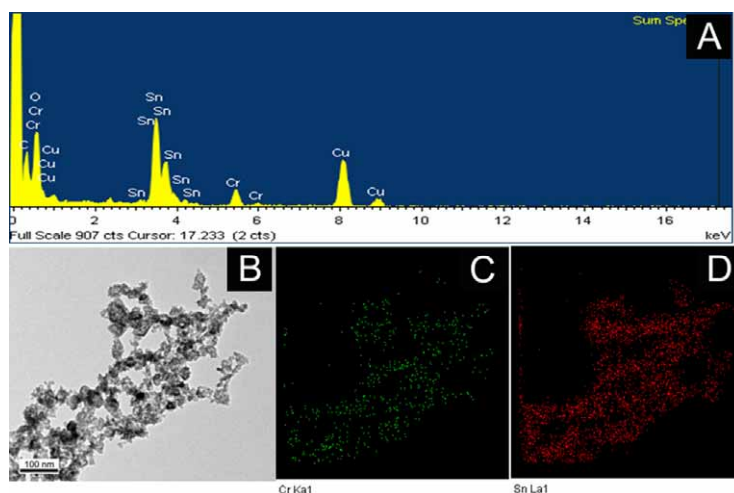


Fig. S2 Primary SnO_x after reduction of hexavalent chromium Cr(VI). (A) EDS spectrum. (B) TEM image of typical nanoparticles. (C), (D) the corresponding surface elements mapping images of Cr and Sn in B.

Figure S3 shows XPS spectra of Cr2p(A), Sn3d(B) and O1s(C) orbitals. Binding energy peak at 577.5eV is corresponding to Cr(III).²⁷ Sn3d spectrum shows that the binding energy at 486.91 eV and 495.35 eV were larger than that of ageing sample at 486.88 eV and 495.35 eV (two weeks). O1s spectrum says that there was only single oxygen (531.5eV) on the surface of nanoparticles. Possibly, the oxides on the surface consists of Sn(IV) and Cr(III) oxides. The atoms ratio of Sn/Cr was roughly estimated to be 16/4.5. The above results were achieved in the presence of light.

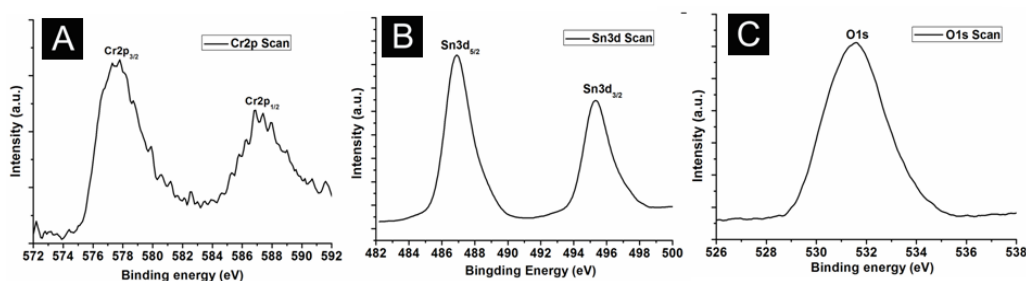


Fig. S3 XPS spectra of SnO_x after Cr(VI) reduction under Sun/UV light. (A) Cr2p scan; (B) Sn3d scan; (C) O1s scan.

Figure S4 displays the UV-spectrum of SnO_x nanoparticles in AgNO₃ solution. When SnO_x colloid was mixed with equal volume of 1mM AgNO₃ solution in the dark, the color of mixed liquid quickly changed from sandy beige to dull black. UV-spectrum of curve b appeared as a broad peak centered at 420 nm belongs to surface plasmon resonance of silver nanoparticles. This experiment demonstrated further that the primary SnO_x nanoparticles have good reducibility.

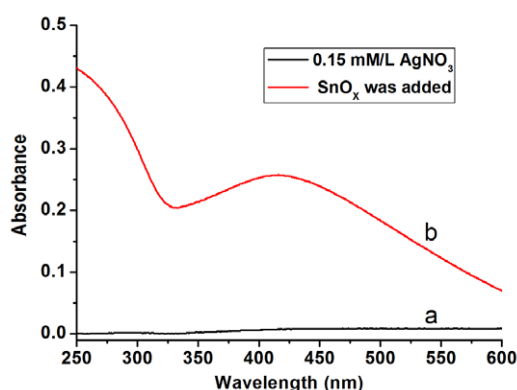


Fig. S4 UV spectra of primary SnO_x nanoparticles in Ag(I) reduction. (a) 0.15 mM/L AgNO₃ solution; (b) after primary SnO_x was added.

Figure 5S gives the SEM image of commercial SnO₂ nanoparticles. The distribution of particles size is broad.

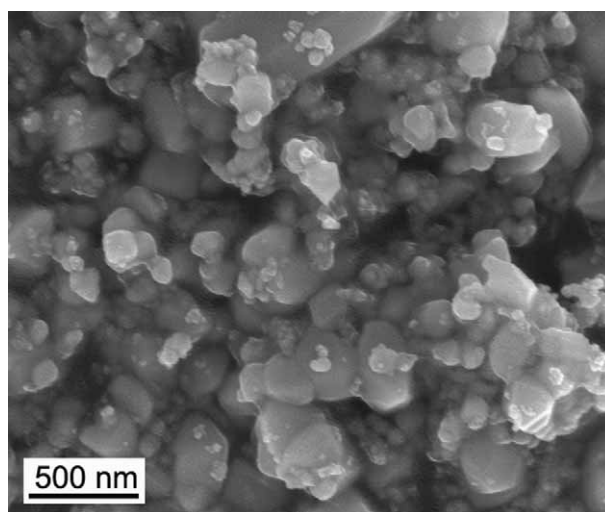


Fig. S5 SEM image of commercial SnO₂ nanoparticles.

Figure S6 displays the effects of commercial SnO₂ on the degradation of MO (A) and reduction of Cr (VI) (B). The degradation experiments are designed to be same as LAL-induced unique SnO_x nanoparticles. Obviously, after long time, small amount of MO degradation occur and almost no reduction occur for Cr (VI) ions contained solution.

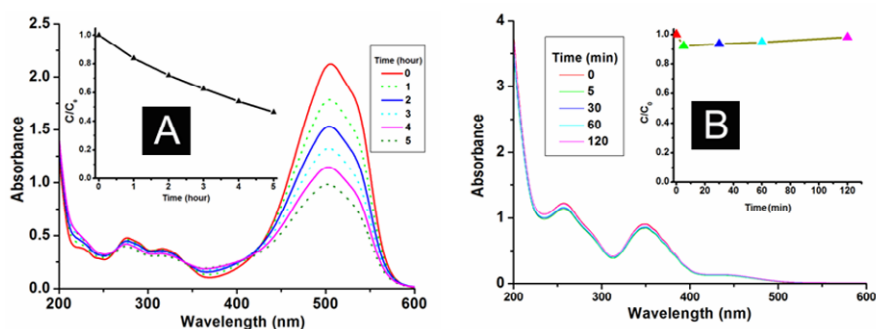


Fig. S6 UV spectra of commercial SnO₂ used in (A) the degradation of methyl orange and (B) the removal/reduction bichromate of potash (Cr(VI)).

Figure S7 gives the TEM and HRTEM images of morphology change of primary SnO_x nanoparticles after UV irradiation for four hours. Aggregated primary SnO_x nanoparticles disappeared and single nanoparticles can be distinguished out easily. Compared with the nanoparticles in aggregated primary SnO_x nanoparticles, the degree of crystallization improved without the particles size changed a lot.

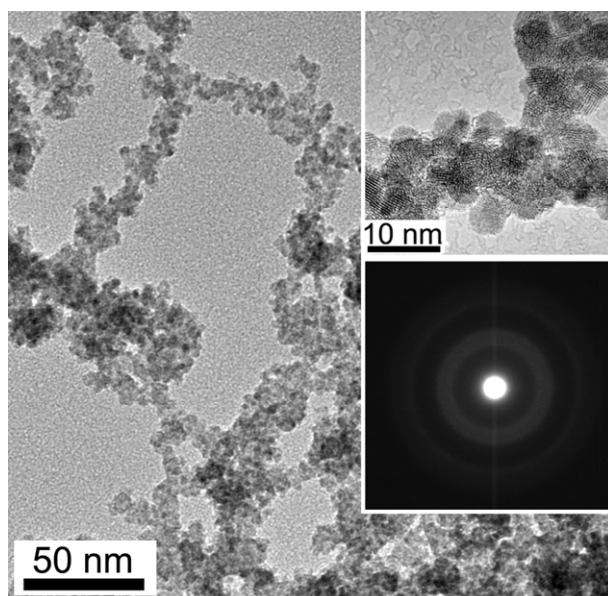


Fig. S7 TEM images of SnO_x nanoparticles illuminated under UV light for 4 hours.

Figure S8 shows the PL spectra of primary and ageing SnO_x nanoparticles colloids. The photoluminescence of SnO₂ that has been widely studied, which was directly bound up with amount and kinds of defects on the surface of SnO_x nanoparticles. The difference of PL spectrum may reflect the changes of defects on the surface of particles to some degree. In Figure S8, for ageing derived nanoparticles, an emission peak at 392 nm appeared and the intensity of additional emission peaks increased.

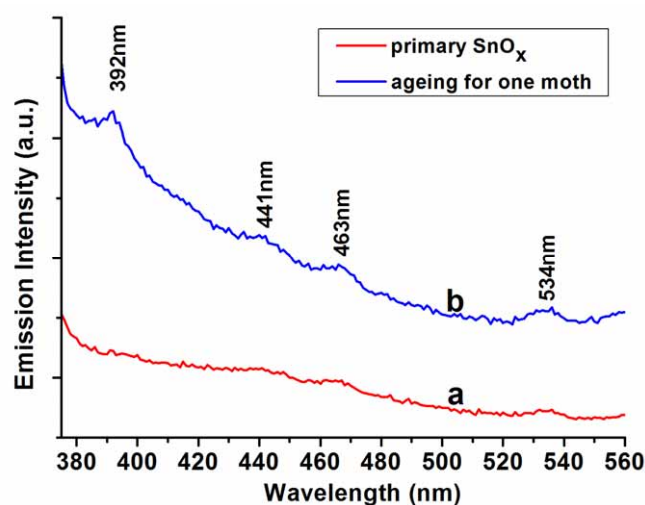


Fig. S8 PL spectrum of (a) primary SnO_x and (b) SnO_x after ageing for one month.