

Electronic Supporting Information

Molybdenum and Tungsten Doped SnO₂ Transparent Conductive Thin Films with Broadband High Transmittance between the Visible and Near-infrared Regions

Xinxin Huo, Shenglin Jiang, Pin Liu, Meng Shen, Shiyong Qiu, and Ming-Yu Li*

*School of Optical and Electronic Information, Huazhong University of Science and
Technology, Wuhan 430074, P. R. China.*

E-mail: mingyuli.oliver@gmail.com.

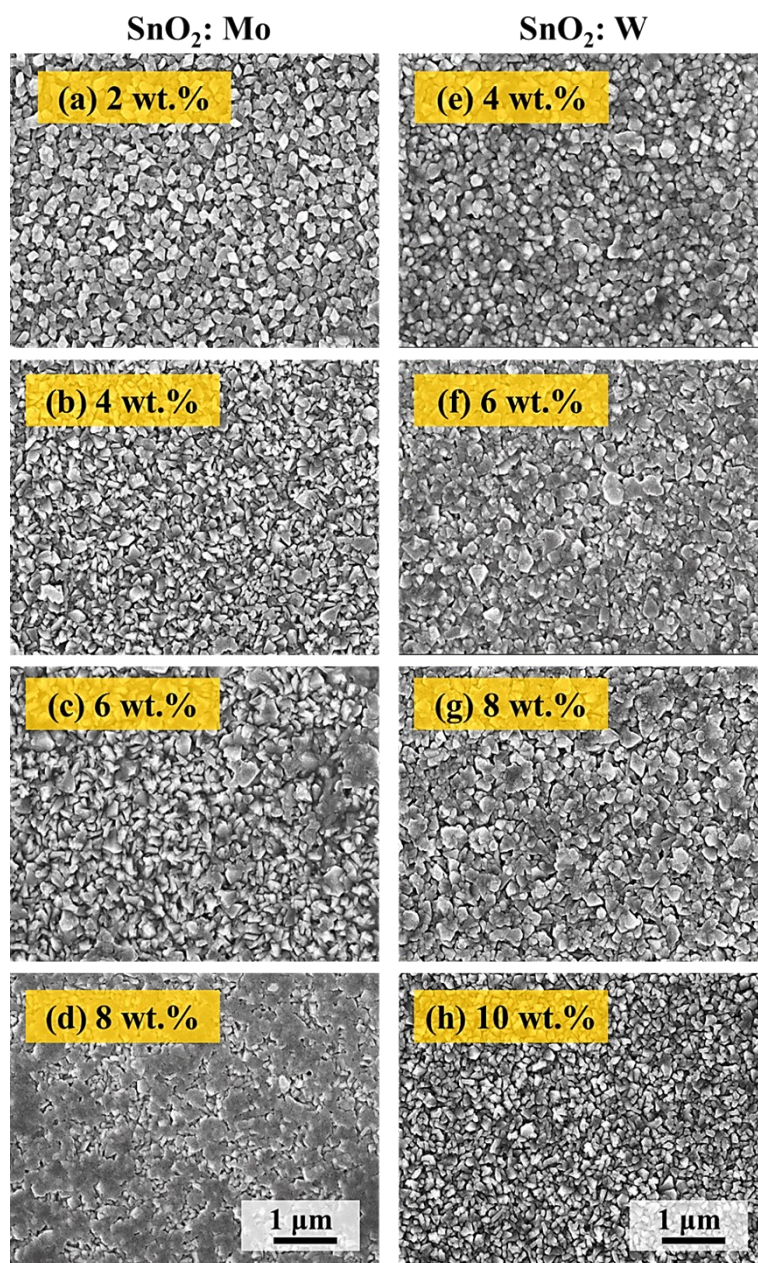


Fig. S1 Scanning Electron Microscopy (SEM) images of SnO₂: Mo and SnO₂: W samples with a variation of doping concentrations: (a) 2 wt.% (b) 4 wt.% (c) 6 wt.% and (d) 8 wt.% Mo, (e) 4 wt.% (f) 6 wt.% (g) 8 wt.% and (h) 10 wt.% W. SEM images are 5.8 (x) × 4.7 (y) μm².

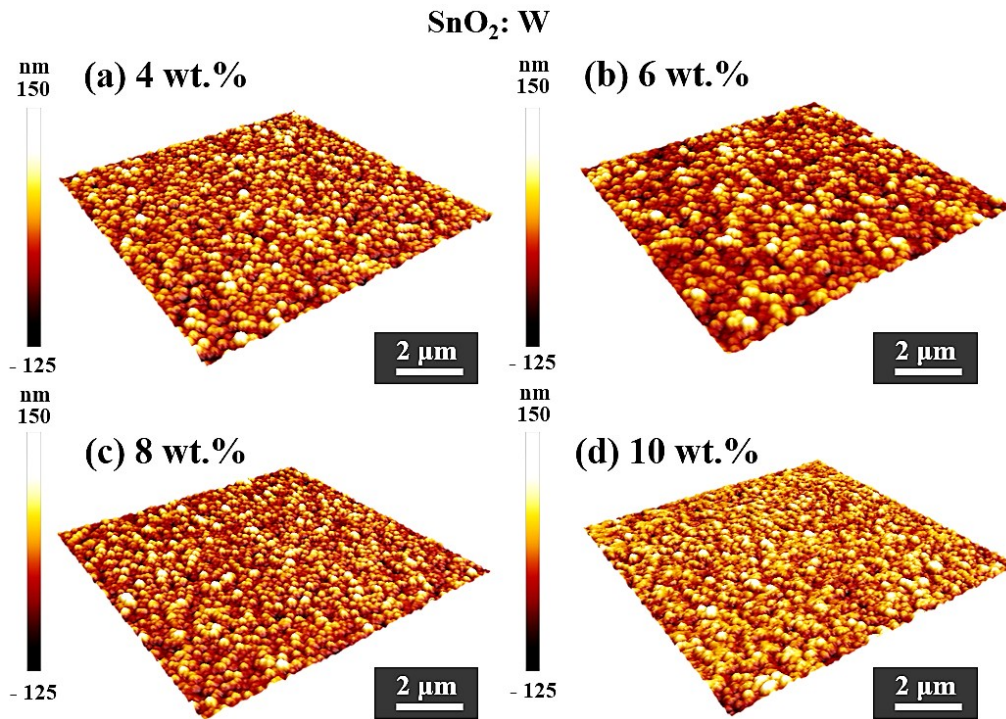


Fig. S2 AFM images of SnO₂: W samples synthesized at 600 °C with various doping concentrations: (a) 4 wt.% (b) 6 wt.% (c) 8 wt.% and (d) 10 wt.%.

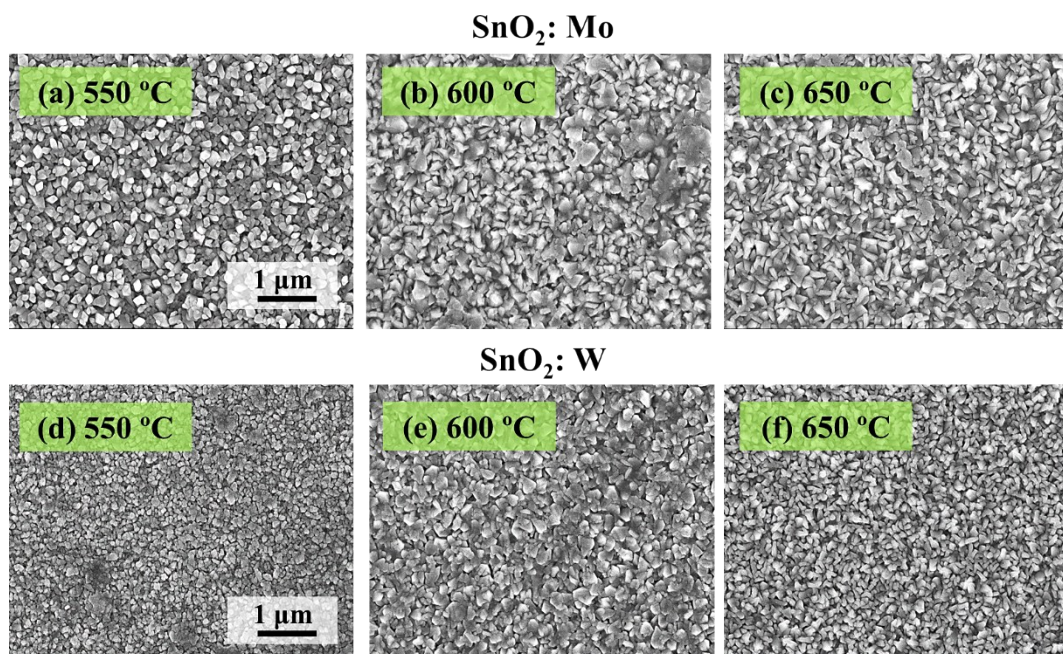


Fig. S3 SEM images of the SnO₂: Mo and SnO₂: W samples synthesized at various annealing temperatures: (a) & (d) 550, (b) & (e) 600, and (c) & (f) 650 °C. SEM images are 5.8 (x) × 4.7 (y) μm².

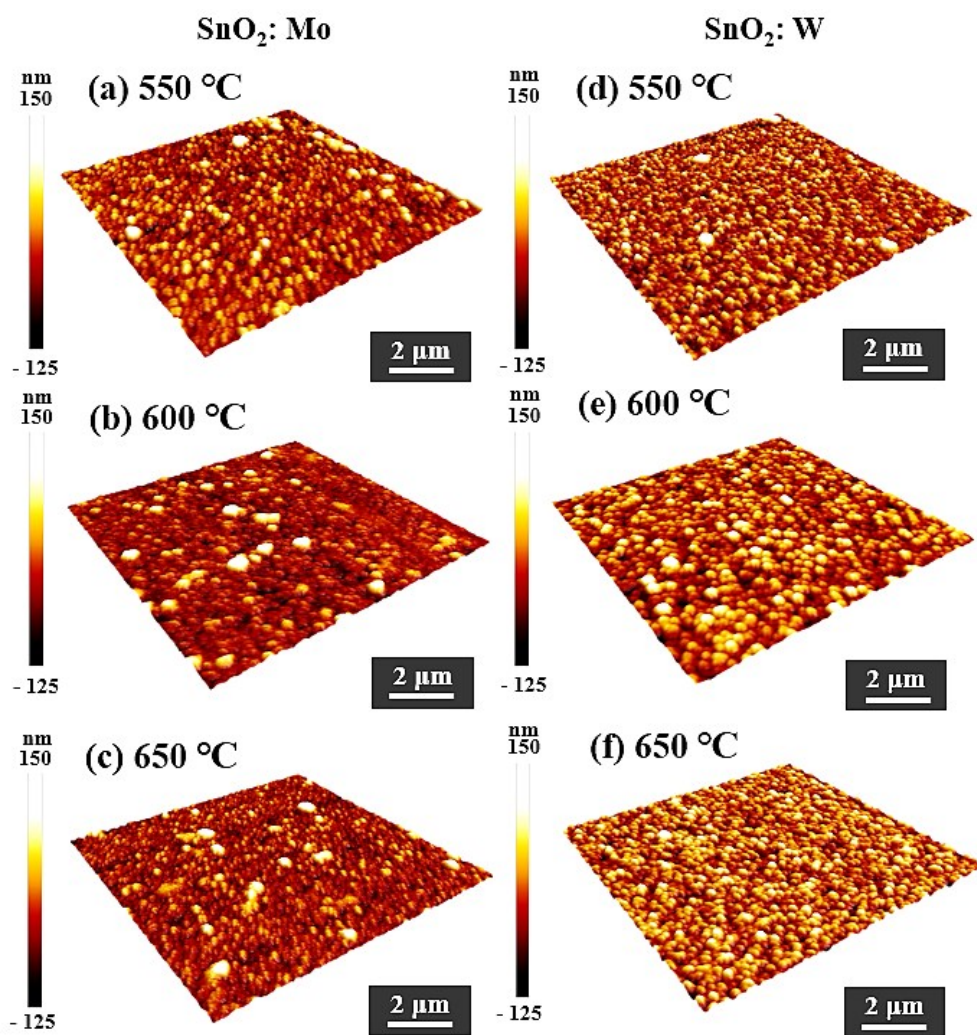


Fig. S4 AFM side-views of $\text{SnO}_2:\text{W}$ samples synthesized at various annealing temperatures: (a) - (d) 550 (b) - (e) 600 and (c) - (f) 650 °C.

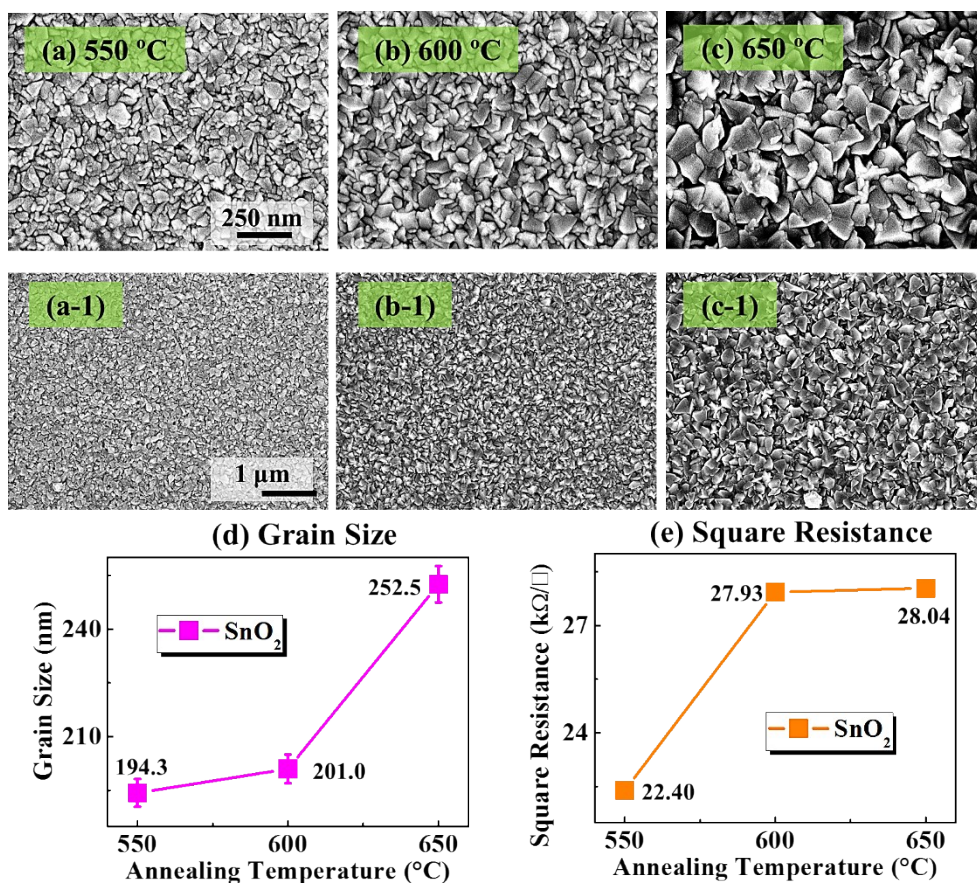
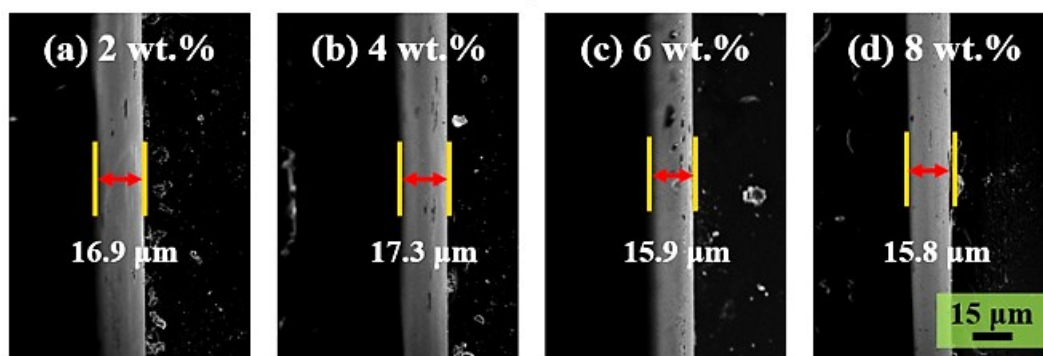


Fig. S5 SEM images of pristine SnO₂ samples synthesized at various annealing temperatures: (a) 550 (b) 600 and (c) 650 °C. SEM images are (a) - (c) 2.2 (x) × 1.8 (y) μm² and (a-1) - (c-1) 5.8 (x) × 4.7 (y) μm². (d) Average grain size of the pristine SnO₂ thin films. (e) Square Resistance of the pristine SnO₂ thin films.

SnO₂: Mo



SnO₂: W

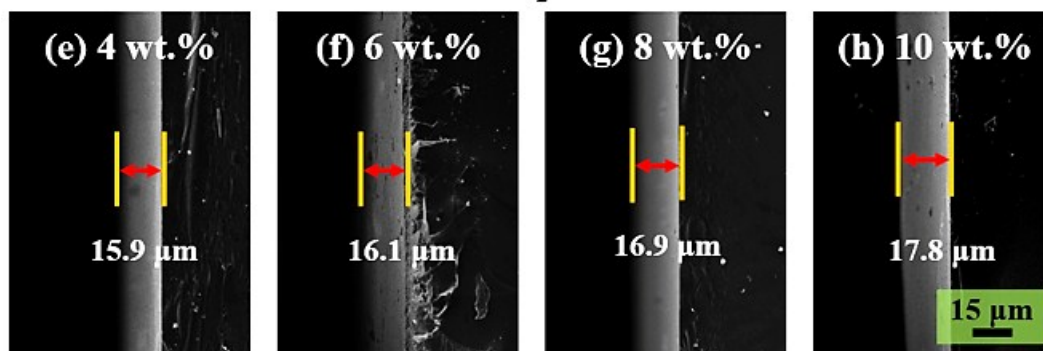


Fig. S6 Cross sectional SEM images of the SnO₂: Mo and SnO₂: W samples synthesized at 600 °C with various doping concentrations: (a) 2 wt.% (b) 4 wt.% (c) 6 wt.% and (d) 8 wt.% Mo, (e) 4 wt.% (f) 6 wt.% (g) 8 wt.% and (h) 10 wt.% W.

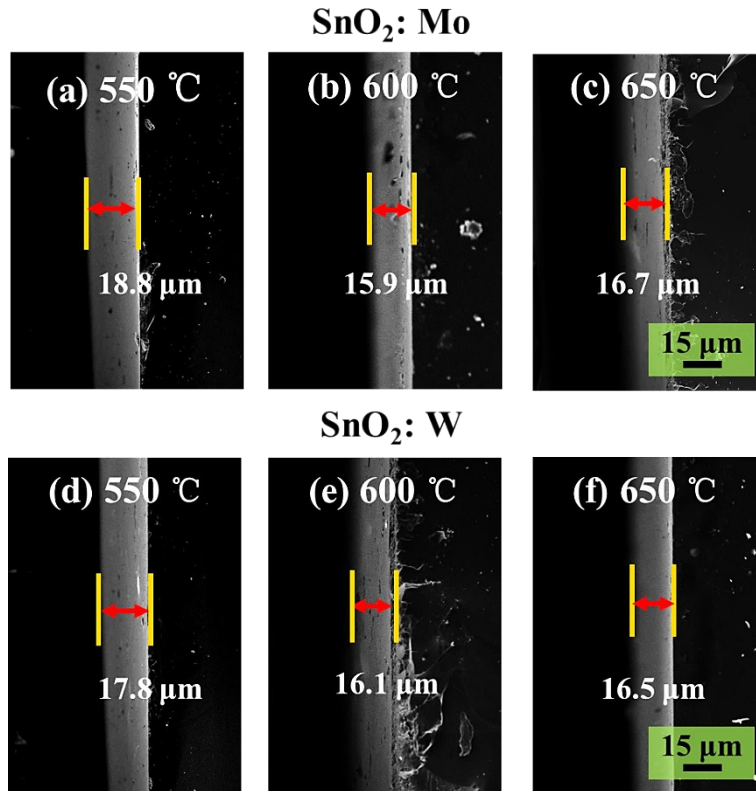


Fig. S7 Cross sectional SEM images of SnO₂: Mo and SnO₂: W samples synthesized at various annealing temperatures: (a) & (d) 550, (b) & (e) 600, and (c) & (f) 650 °C.

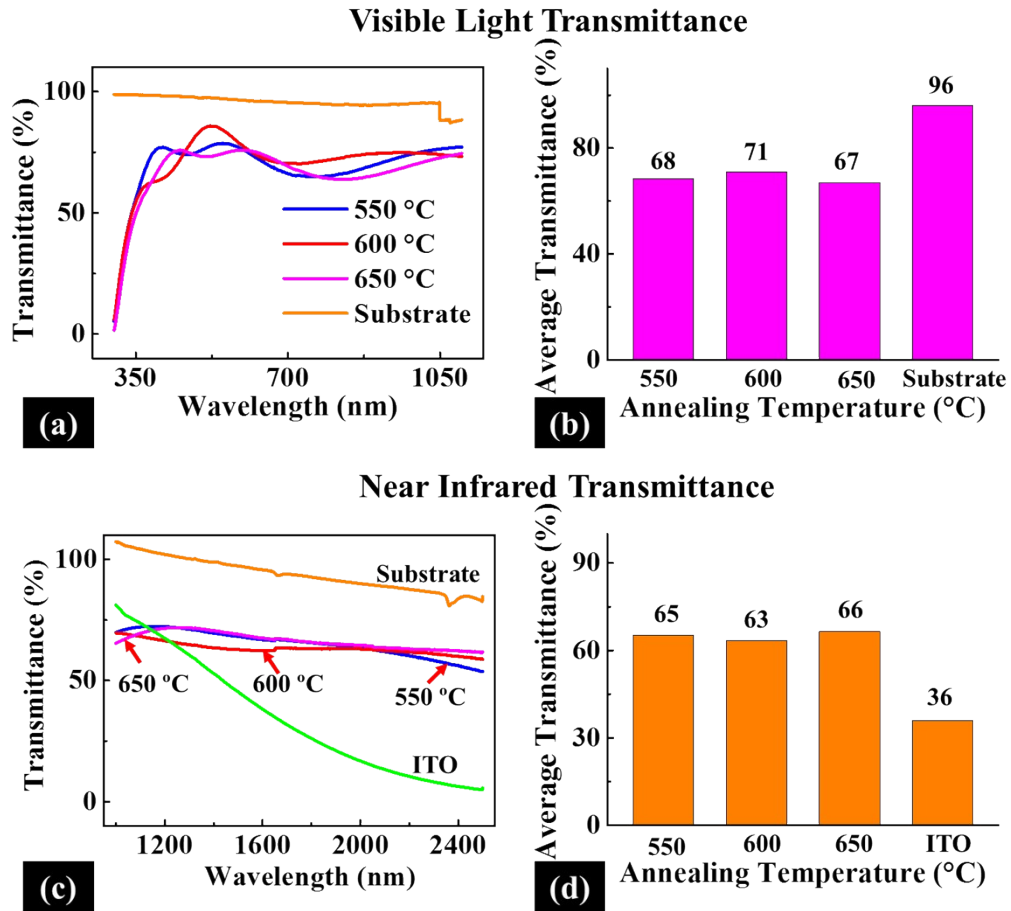


Fig. S8 (a) Visible transmittance spectra and (b) average transmittance over a wavelength range between 300 and 1100 nm of un-doped SnO₂ thin films annealed at various temperatures between 550 and 650 °C. (c) Near infrared (NIR) transmittance spectra over a wavelength range between 1000 and 2500 nm of un-doped SnO₂ samples annealed at various temperatures between 550 and 650 °C. (d) The corresponding average transmittance of un-doped SnO₂ thin films.

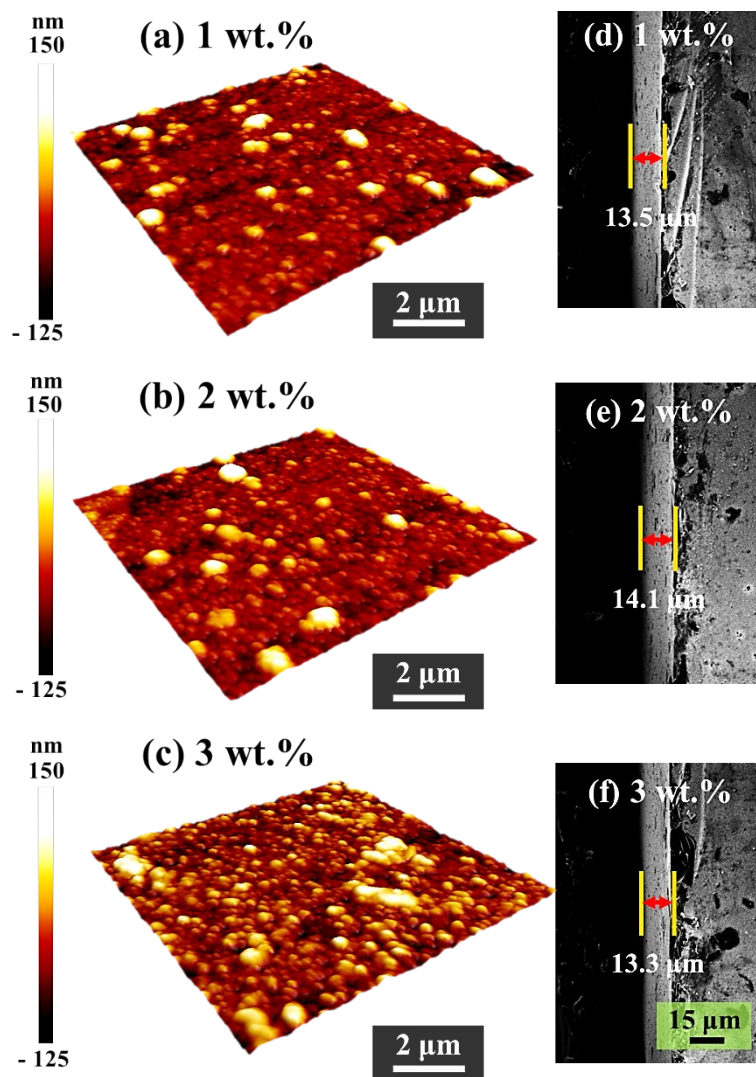


Fig. S9 AFM images of SnO₂: Mo: W samples synthesized at 600°C by varying the W doping concentrations with a fixed Mo concentration of 2 wt.%. (a) 1 wt.% (b) 2 wt.% and (c) 3 wt.% W. (d) - (f) Cross sectional SEM images of the co-doped SnO₂ samples.