Supporting Information

Amelioration of interfacial combination and suppression of oxygen vacancies for high performance environmentally friendly electrospun SnYO nanofibers field-effect transistors

Jun Li,*[a, b] Qi Chen,[a] Yaohua Yang,[a] Wenqing Zhu [a], Xifeng Li,[b] and Jianhua Zhang[b]*

[a] School of Material Science and Engineering, Shanghai University, Jiading, Shanghai 201800, People's Republic of China

[b] Key Laboratory of Advanced Display and System Applications, Ministry of Education, Shanghai University, Shanghai 200072, People's Republic of China

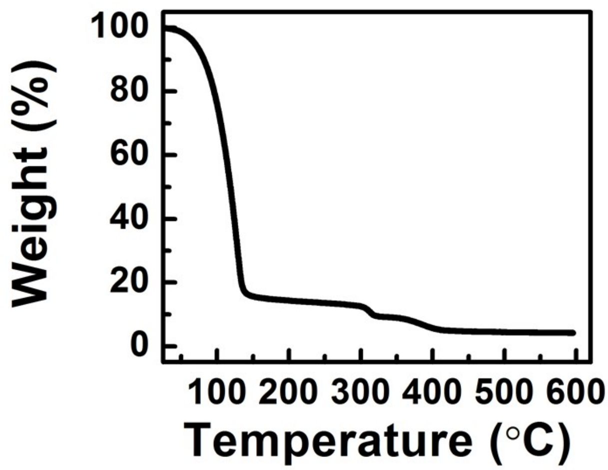

Fig. S1 Thermal behavior of SnO_2 precursor solution.

Fig. S1 shows the thermal properties of the SnO_2 precursor solutions by means of thermogravimetric (TG) analysis with a heating rate of ~10°C/min. The TG curve of the SnO_2

* Corresponding author: E-mail address: lijun_yt@shu.edu.cn (J. Li), jhzhang@oa.shu.edu.cn (J. H. Zhang)

precursor solutions exhibits a three-step reduction in weight. The drastic mass loss in the first step could be due to the evaporation of moisture and residual solvent. In the second step, the weight loss between 280 and 330 °C could arise from the metal-to-oxygen (M-O) formation followed by the below reaction (1) and (2). In the final step, the weight loss at ~450 °C could be attributed to the thermal decomposition of the PVP chains. In this work, the annealing temperature at 500 °C should be chosen because all reactions has been carried out and there is no change in weight loss, indicating the removal of organic PVP and formation of pure SnO_2 nanofibers.

$$SnCl_4 + 4H_2O \rightarrow Sn(OH)_4 + 4HCl \quad (1)$$

$$Sn(OH)_4 \rightarrow SnO_2 + 2H_2O \quad (2)$$

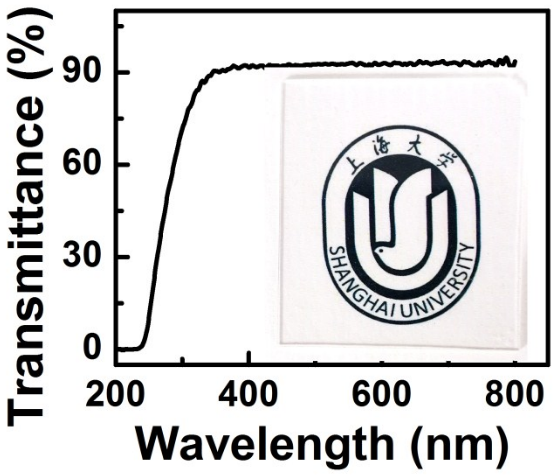

Fig. S2 Optical transmission spectra of SnO_2 nanofibers .

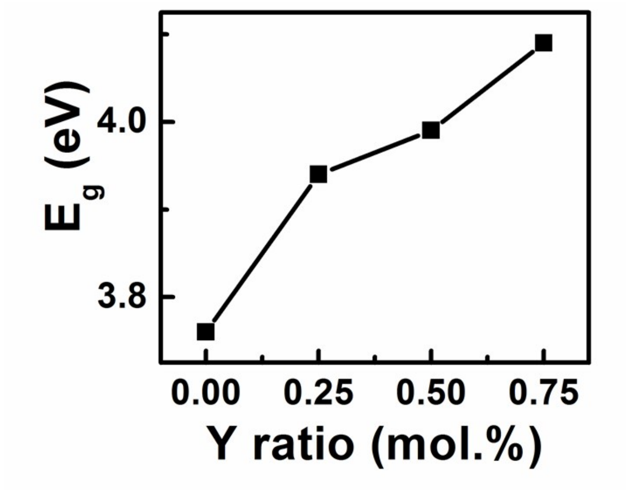

Fig. S3 The calculated E_g for SnYO nanofibers with different concentrations.

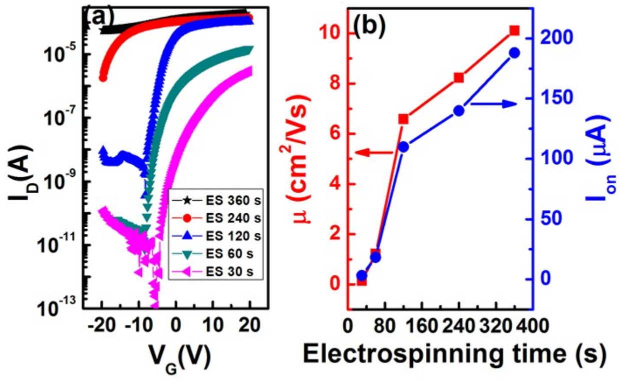

Fig. S4 (a) Transfer curves of SnO_2 nanofibers FETs with different electrospinning time. (b) Electrical parameters of μ and I_{on} as a function of electrospinning time for SnO_2 nanofibers FETs.

The nanofibers network channel coverage controlled by the electrospinning time also plays a key role in the nanofibers FETs electrical performance. Fig. S4(a) shows the transfer curves of SnO_2 nanofibers FETs with different electrospinning time. The performance parameters of the FETs are summarized in Fig. S4(b). The results imply that the FETs performance is strongly depend on the nanofibers network channel coverage. When the electrospinning time is 30 s, the device shows a poor electrical parameter, including a low I_{on} of 3.12 μA and μ of 0.15 cm^2/V·s. With the increase in the electrospinning time, I_{on} and μ are gradually improved due to the production of the more conducting path for carrier electrons. Although the device shows the high

μ of 10.12 $cm^2/V{\cdot}s$ with the electrospinning time of 360 s, the poor switching characteristics are clearly observed resulting from the overlapping of the nanofibers, which is not suitable for practical applications. The nanofibers FETs with the optimized electrospinning time of 2 min exhibit a better electrical performance, including a better I_{on} of 104 μA and a μ of 6.21 $cm^2/V{\cdot}s$. Therefore, it is plausible that the formation of sufficient nanofibers network and adequate electrospinning time are of great importance to the nanofibers FETs electrical properties.

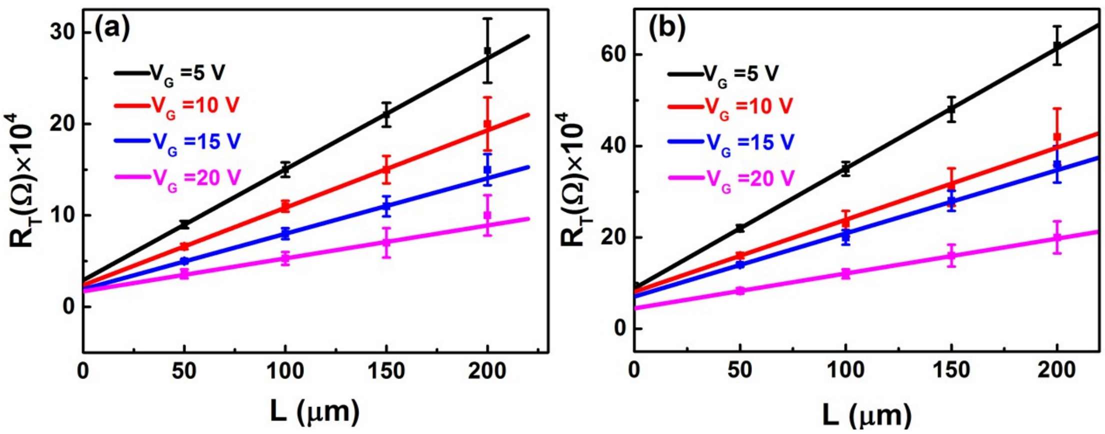

Fig. S5 The contact resistance with different channel length for (a) SnO_2 nanofibers FETs and (b) $SnY_{0.5\%}O$ nanofibers FETs.

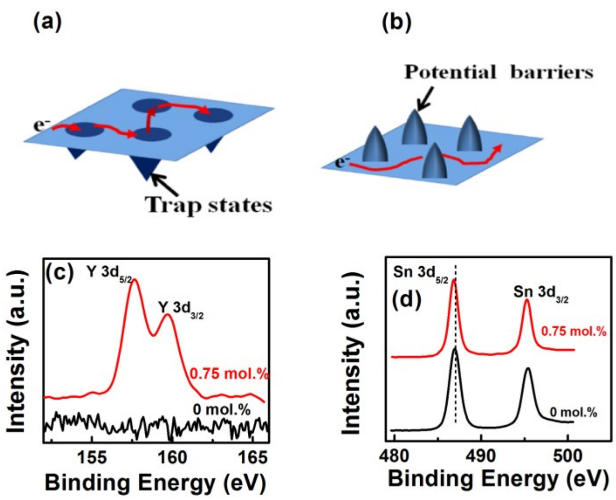

Fig. S6 Schematic Representation (a) TLC and (b) PC Conduction Mechanism**.** (c) Y 3d and (d) Sn 3d XPS spectrum with various Y doping ratios.

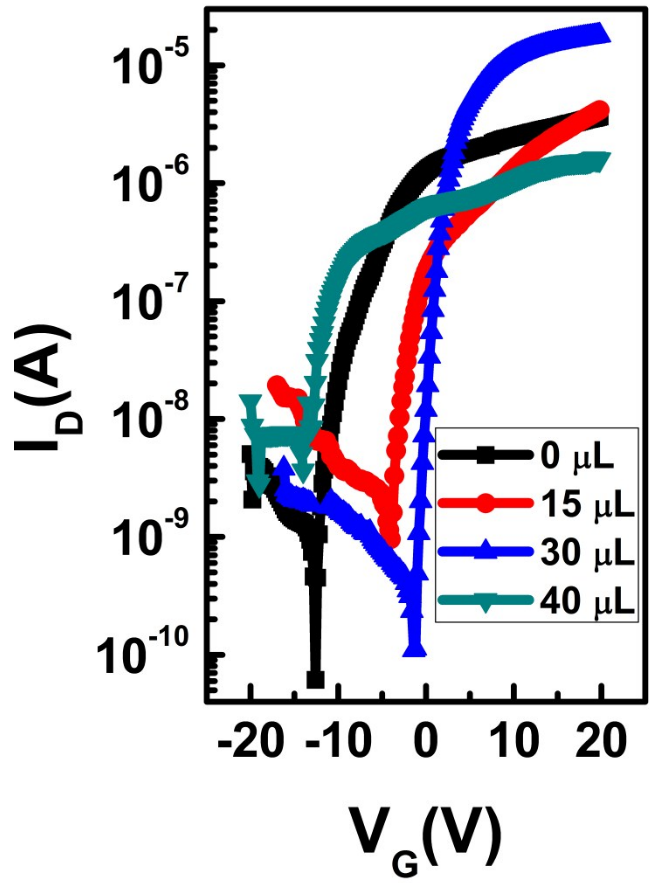

Fig. S7 Transfer curves of $SnY_{0.5\%}O$ nanofibers FETs with different EA volumes.

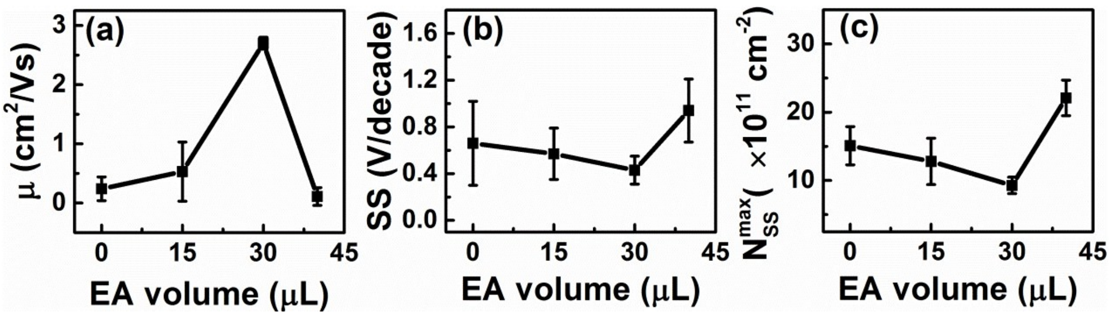

Fig. S8 The electrical parameters of $SnY_{0.5\%}O$ nanofibers FETs with various EA contents.

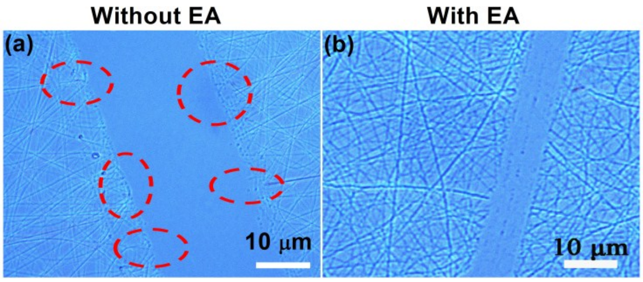

Fig. S9 Scraping tests of nanofibers (a) without and (b) with EA addition.

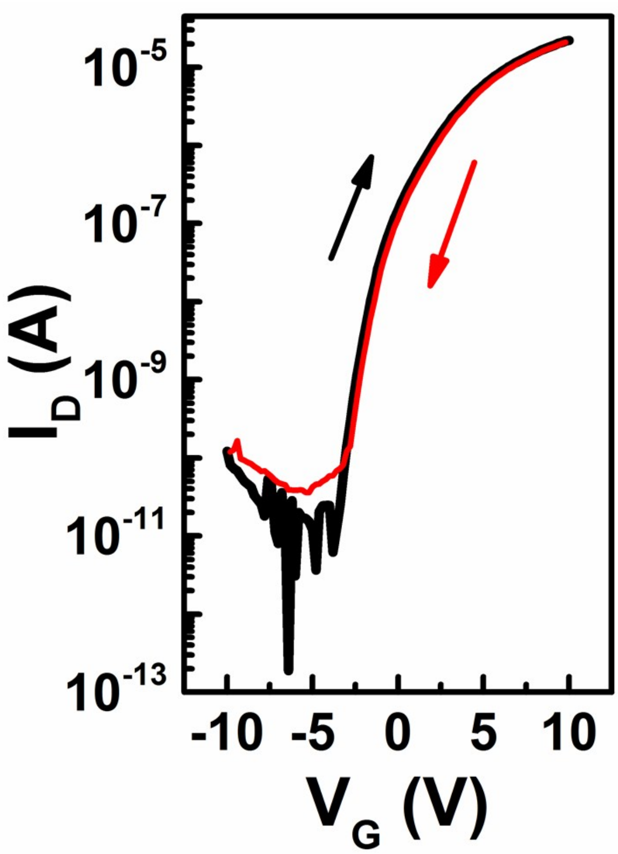

Fig. S10 Transfer curves of SnYO nanofibers/$ZrAlO_x$ FETs (V_D=10 V) measured with forward and reverse gate voltage sweeps

The mobility (μ) can be calculated by the following expression:

$$I_D = \frac{WC_i}{2L}\mu(V_G - V_T)^2 \tag{3}$$

where C_i (24 nF/cm^2) is the areal capacitance of the SiO_2 dielectric, W and L are the channel width and length, respectively. V_G and V_T are the gate voltage and threshold voltage, respectively. The subthreshold voltage (SS) can be calculated by the following equation:

$$SS = \frac{dV_G}{dlog(I_D)} \tag{4}$$

The maximum trap density (N_{SS}^{max}) can be obtained using,

$$N_{SS}^{max} = \left[\frac{SS\ log(e)}{kT/q} - 1\right]\frac{C_i}{q} \tag{5}$$

where k, T and q represent Boltzmann's constant, absolute temperature and charge quantity, respectively.