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Enhanced resistive switching effect by illumination in self-assembly $NiWO_4$ nano-nests

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Supplementary Information

1. Preparation details of $NiWO_4$:

In our case, self-assembly $NiWO_4$ nano-nests grown on Ti substrate were synthesized by hydrothermal method. Analytical $Na_2WO_4 \cdot 2H_2O$ (0.05 mol) and $Ni(NO_3)_2 \cdot 6H_2O$ (0.05 mol) were first dissolved in 40 ml deionized water with stirring, followed by addition of 0.5 g cationic surfactant cetyltrimethylammonium bromide (CTAB). After stirring continuously for 2 hour, 2.0 g of NaOH was added with stirring for 30 min. Finally the solution was transferred to a 50 ml sealed Teflon-lined stainless steel autoclave. The cleaned Ti substrate was placed in the solution in autoclave. Then the autoclave was kept at 220 ^oC for 72 hours. After the autoclave was cooled to room temperature, the Ti substrate was rinsed by deionized water and subsequently dried at 60 ^oC for overnight.

2. Material characteristics

Microstructure of $NiWO_4$ nano-nests was characterized by X-ray diffraction (XRD, Shimadzu

XRD-7000 X-ray diffractometer) with Cu *K*α radiation. Surface morphology of $NiWO_4$ nano-nests grown on Ti substrate was characterized using scanning electron microscopy (SEM, JSM-6510). The microstructure, selected area electron diffraction (SAED) pattern and the energy dispersive X-ray spectroscopy (EDS) spectra of the $NiWO_4$ nano-nests were observed by transmission electron microscopy (JEM-2100) at an acceleration voltage of 200 kV. For the characterization of UV-vis absorption spectrum, in order to exclude the interference of Ti substrate, we have scraped off $NiWO_4$ nano-nests from the Ti substrate for UV-vis absorption spectrum characterization.

3. Device characteristics

In the test of resistive switching effect, Ag and Ti are the top electrode and bottom electrode, respectively, where the Ag electrode with area of about 1 mm^2 was prepared by vacuum deposition. Current-voltage (I-V) characterizations were tested using the electrochemical workstation CHI-660D.