

# **Europium ions doped WO<sub>3</sub> film with bi-function of enhanced electrochromic switching and tunable red emission**

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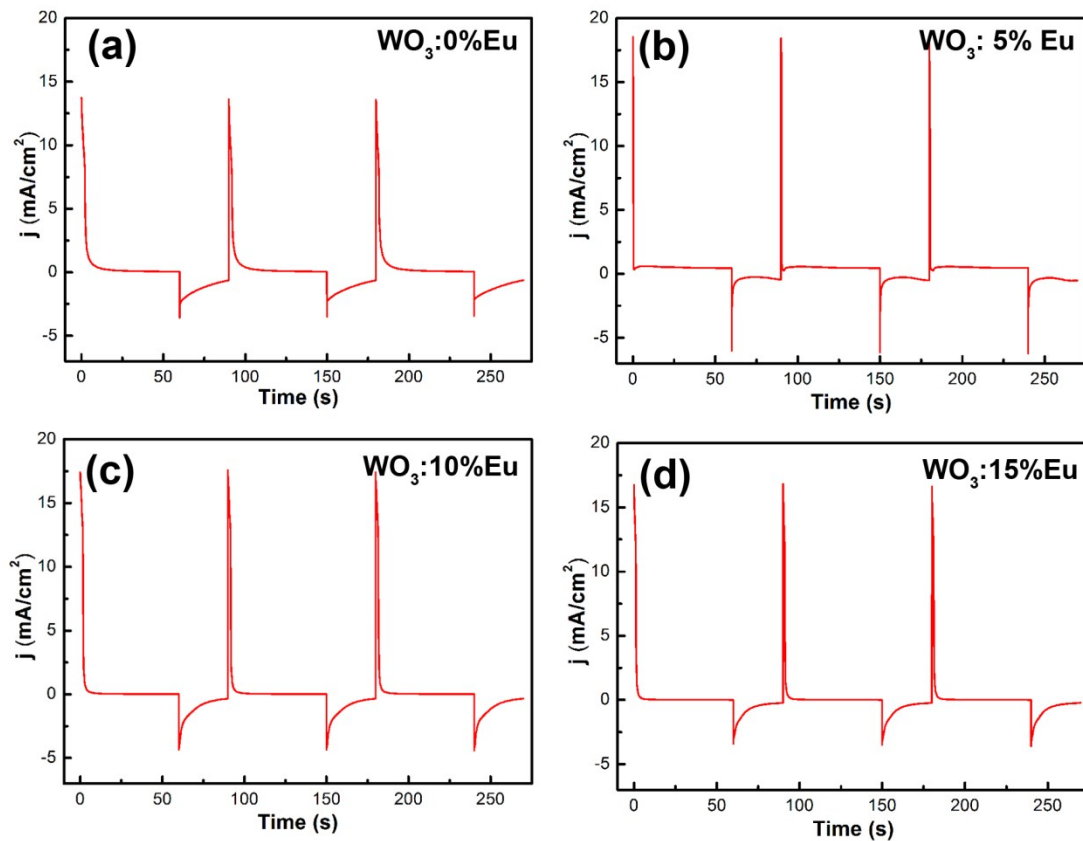
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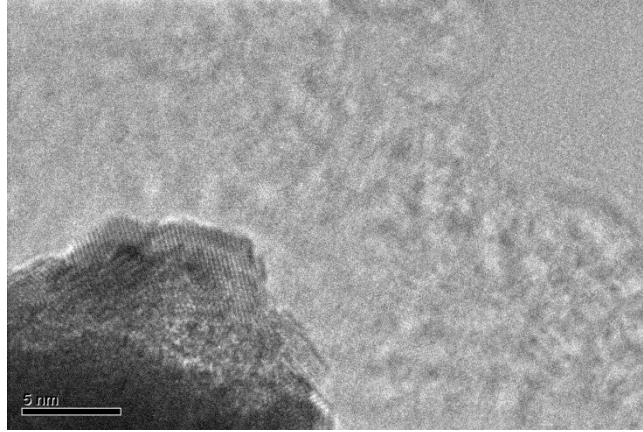
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**Fig. S1** double-step chronoamperometry curves of  $\text{WO}_3:\text{xEu}$  (x=0, 5%, 10%, 15%) films measured in 0.5 M  $\text{H}_2\text{SO}_4$  aqueous electrolyte.

To characterize the charge capacity of all films in EC switching process, all the films were colored under -1 V in 0.5 M  $\text{H}_2\text{SO}_4$  electrolyte for 20 s and then bleached at 1.5 V for 20 s by using double-step chronoamperometry technique. The integral area between chronoamperometry curve and Y axis represents the charge capacity. The charge capacity for  $\text{WO}_3:\text{xEu}$  (x=0, 5%, 10%, 15%) films in coloration process are calculated to be 34.68 mC, 4.16 mC, 18.73 mC and 17.05 mC, respectively.



**Fig. S2** High resolution TEM graph of WO<sub>3</sub>: 10% Eu film.

To characterize the structure of WO<sub>3</sub>: 10% Eu film, TEM graph at high resolution is collected and shown in Fig. S2. It can be seen that the nanoparticle shows poor crystallinity, indicating its amorphous structure.