Supplementary Materials: Conductive Cotton for Affordable and Efficient Water Purification

Fang Li, Qin Xia, Qianxun Cheng, Mingzhi Huang, and Yanbiao Liu *

Supplementary materials： 5 figures.

Liquid chromatography-mass spectrometry (LC-MS) methods.

LC-MS analysis of tetracycline was performed on an Agilent 1290 UHPLC system coupled to 6540 quadrupole-time of flight (Q-TOF) mass detector. The column used for the separation was an Agilent rapid resolution HT zorbax SB-C18 (2.1 × 50 mm, 1.8 μm). The oven temperature was maintained at 35°C and the gradient elution involved a mobile phase consisting of (A) 0.1% formic acid in water and (B) 0.1% formic acid in acetonitrile. The following solvent gradient was applied: from 11% (B) to 15% (B) between 1.01 – 3.30 min and from 15% (B) to 32% (B) between 3.31 – 5.00 min and then return to initial conditions between 5.01 – 5.50 min. Flow rate was set at 0.4 mL min^{-1} and 5 μL of samples was injected. The electrospray ionization-mass spectrometry (ESI-MS) was acquired in positive ion mode and the ion spray voltage and nozzle voltage was set at 4,000 V and 1,000 V, respectively. The nebulizer nitrogen gas flow rate was set at 55 psi.

Energy Consumption Calculation.

Under experimental conditions of $[CNT]_{ink}$ = 1.5 mg/mL, $[TC]_{in}$ = 0.2 mmol/L, $[Na_2SO_4]$ = 10 mmol/L, and flow rate = 1.5 mL/min. The energy consumption at an applied total cell potential of 2.0 V can be calculated as follow.

$$0.0025\,A \times 2.0\,V = 0.005\,\frac{J}{sec}$$

$$\frac{0.005 \times 10^{-3}\,\frac{kJ}{sec} \times \frac{0.00028\,kwh}{kJ}}{0.0015\,\frac{L}{min} \times \frac{min}{60\,sec} \times \frac{m^3}{1000L}} = 0.05\,\frac{kWh}{m^3}$$

By assuming 31 e$^-$ transfer, the energy per theoretical chemical oxygen demand is calculated as follow.

$$0.2 \times 10^{-3}\,\frac{mol}{L} \times 0.0015\,\frac{L}{min} \times \frac{min}{60\,sec} \times \frac{31e^-}{Molecule} \times \frac{6.02\ \times 10^{23} molecules}{mol}$$
$$\times \frac{O_2\,molecule}{4e^-} \times \frac{mol}{6.02\ \times 10^{23} molecule} \times \frac{32\,g}{mol} = 1.24 \times 10^{-6}\,\frac{g\,O_2}{sec}$$

$$\frac{0.005 \times 10^{-3}\,\frac{kJ}{sec}}{1.24 \times 10^{-6}\,\frac{g\,O_2}{sec}} \times \frac{1000\,gO_2}{kgO_2} \times \frac{0.00028\,kwh}{kJ} = 1.2\,\frac{kWh}{kg\,ThCOD}$$

ThCOD is the theoretical chemical oxygen demand.

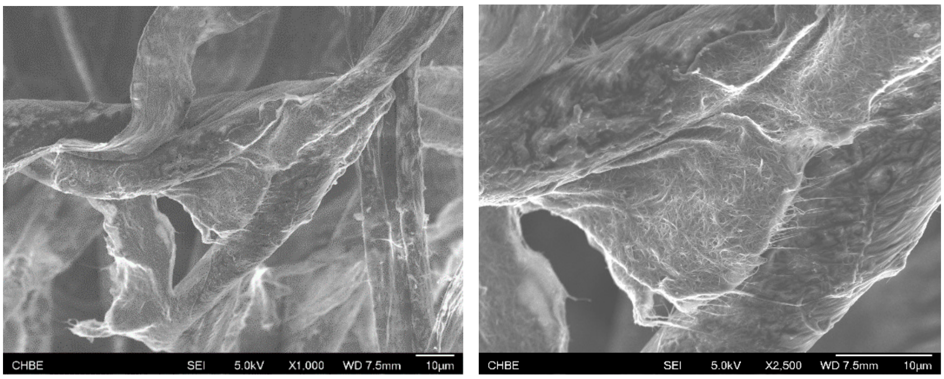

Figure S1. FESEM images of conductive cotton filters fabricated using $[CNT]_{ink}$=1.5 mg/mL.

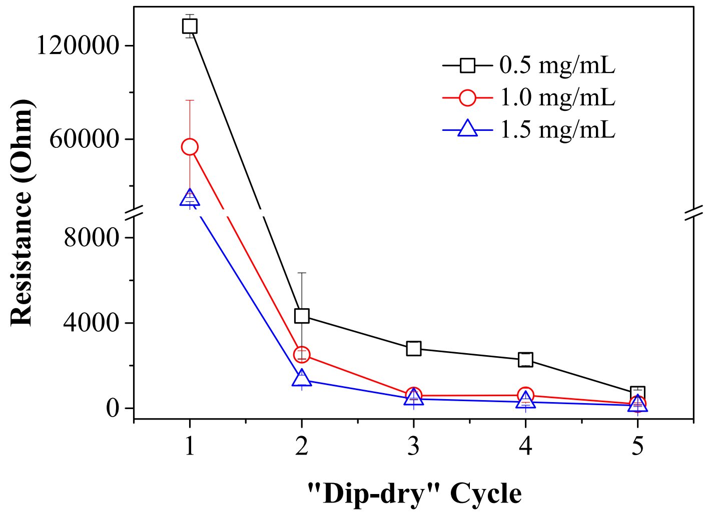

Figure S2. Variation of filter resistance of as-fabricated cotton filters with CNT ink concentrations. The resistance was measured by a multimeter and at least 50 measurements was conducted for one data point.

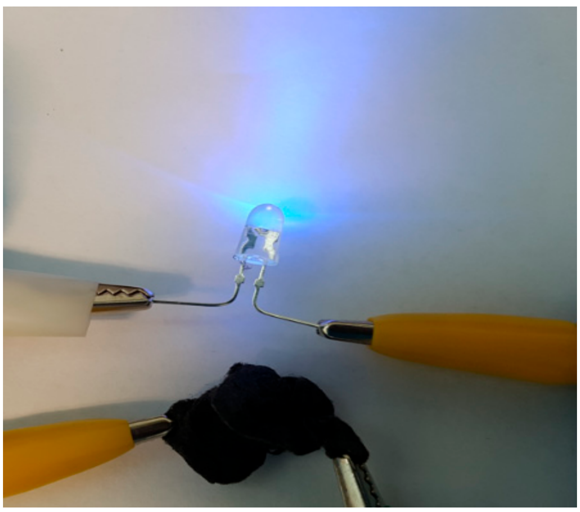

Figure S3. Demonstration of the CNT cotton filter acts as a conducting path in the emission of an LED indicative lamp under applied voltage of 4 V.

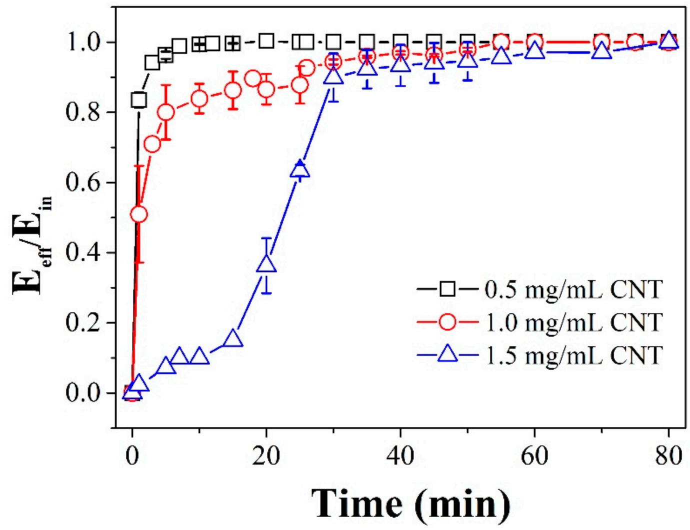

Figure S4. MO breakthrough curve under conditions of [MO]in=0.06 mmol/L, [Na_2SO_4]=10 mmol/L, and flow rate=1.5 mL/min.

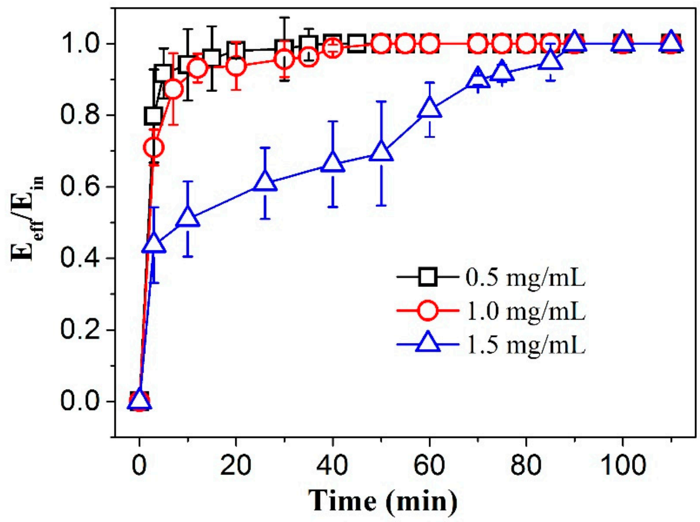

Figure S5. TC breakthrough curves under conditions of $[TC]_{in}$=0.2 mmol/L, [Na_2SO_4]=10 mmol/L, and flow rate=1.5 mL/min.