

Supplementary Information

**Multifunctional Necklace-like Cu@Cross-Linked Poly(vinyl alcohol)  
Microcables with Fluorescent Property and Their Position Manipulation  
by an External Magnet**

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***Experimental sections:***

**Chemicals.** The chemicals iron (III) acetylacetonate ( $\text{Fe}(\text{accac})_3$ , 99%) were purchased from Alfa Aesar. Triethylene glycol (TREG), copper (II) chloride dihydrate ( $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ ), copper (I) chloride ( $\text{CuCl}$ ), poly(vinyl alcohol) (PVA, Degree of polymerization is 1750) and ethanol were purchased from the Shanghai Reagent Company (P. R. China). All the chemicals were used as obtained without further purification.

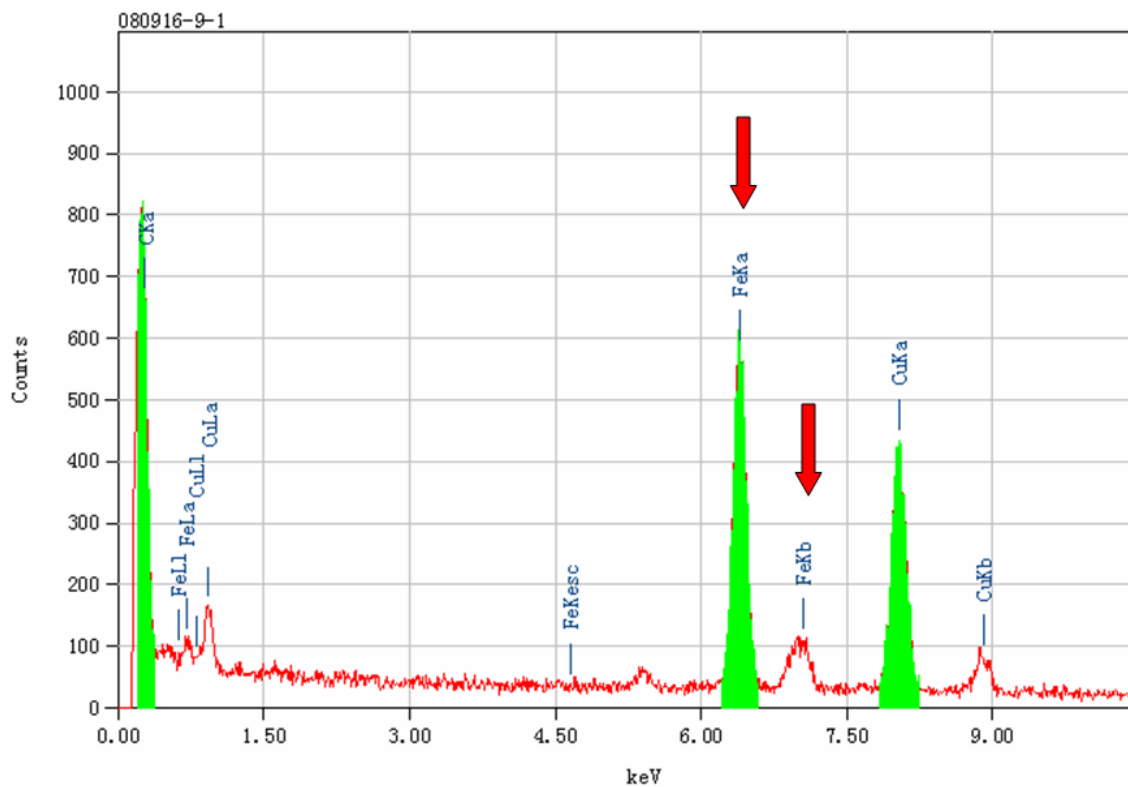
**Preparation of necklace-like Cu@PVA microcables.** Necklace-like Cu@crosslinked poly(vinyl alcohol) microcables were prepared using the technique reported previously in ref. 15. In a typical method,  $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$  (0.017 g,  $10^{-4}$  mol) and  $\text{CuCl}$  (0.02 g,  $2 \times 10^{-4}$  mol) were dispersed in 18 mL of modulated PVA solution (1.5 wt %, pH 9.5, modulated by NaOH solution). Then the whole mixture was transferred into a Teflon-lined autoclave with a capacity of 22 mL. After stirring for half an hour, the autoclave was sealed and maintained in an oven of 200 °C for 3 days. Through the reaction, a brown-red floccule was formed, which was washed with distilled water and ethanol for several times to remove ions and possible remnants and vacuum dried for further utility.

### **Preparation of Magnetite-nanoparticles-attached necklace-like Cu@PVA microcables.**

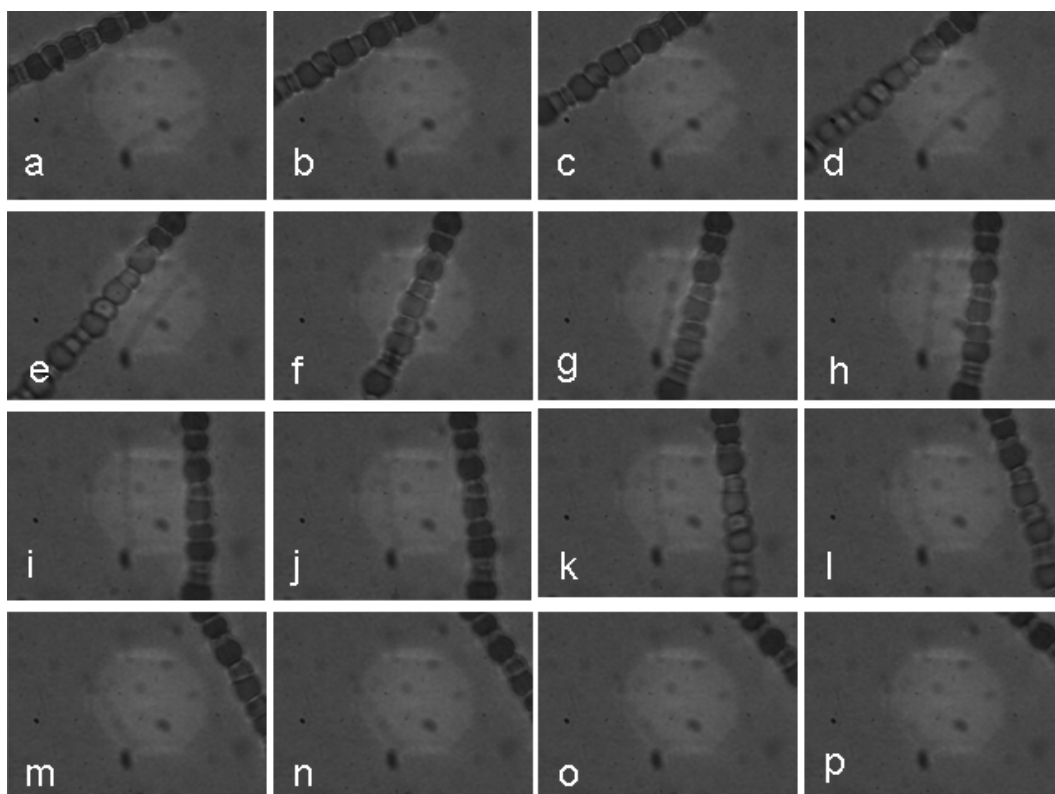
Magnetite-nanoparticles-attached necklace-like Cu@crosslinked poly(vinyl alcohol) microcables were prepared by in-situ synthesizing magnetite in the cross-linked PVA sheaths via vacuum thermal reduction method. Into a 20 ml glass tube was added a mixture of prepared necklace-like Cu@PVA microcables (0.030 g), Fe(acac)<sub>3</sub> and TREG. After three freeze-vacuum-thaw cycles, the tube was sealed under vacuum and then placed in a thermostated bath at 135 °C. After complete swelling for 1h, the sealed tube was quickly transferred into another oil bath and maintained at 220 °C for 3 h. The resultant floccules were centrifuged at 3000 r/min and washed with distilled water and anhydrous alcohol several times, and then dried in vacuum at 60 °C for 10 h.

**Materials characterization.** The samples were characterized by powder X-ray power diffraction (XRD), using a Philips X'Pert PRO SUPER X-ray diffractometer equipped with graphite monochromatized Cu K $\alpha$  radiation ( $\lambda = 1.54056 \text{ \AA}$ ), the operation voltage and current were maintained at 18 kV and 400 mA, respectively. The morphologies of the samples were further characterized with field emission scanning electron microscope (FESEM, JEOL JSM-6700F, operated at 5 kV), high resolution transmission electron microscopy performed on a JEOL-2010 transmission electron microscope (HRTEM) and Olympus optical microscope. Local EDS analysis was performed using a OXFORD INCA system with the smallest analysis spot of 10 nm. The magnetic properties of samples were investigated using a superconducting quantum interface device (SQUID) magnetometer (Quantum Design MPMS XL). Photoluminescence emission was performed at room temperature with a Perkin–Elmer LS55 luminescence spectrometer. Fluorescent image was

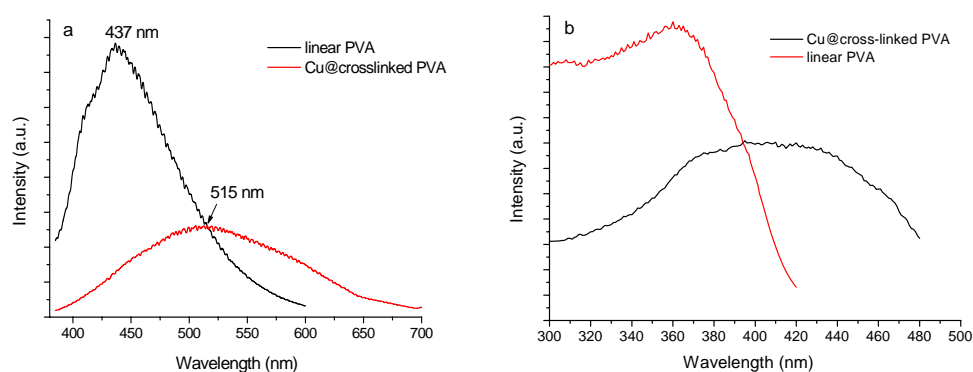
recorded under a Zeiss Axiovert 200 fluorescence microscope and Axiocam-HS digital camera.



**Figure S1.** Energy disperse spectrum (EDS) taken on the selected area of magnetite-nanoparticles-attached necklace Cu@cross-linked poly(vinyl alcohol) microcables prepared in the presence of  $0.5 \times 10^{-4}$  mol Fe(acac)<sub>3</sub>.



**Figure S2.** Photographs of oriented continuous waggle and rotation of individual magnetite-nanoparticles-attached microcable manipulated by external magnetic field ( $M = 0.15$  T). (a)-(p) are typical photographs of continuous process by waggling the cable anticlockwise.



**Figure S3.** The room-temperature PL spectra of pure linear poly(vinyl alcohol) and pure necklace-like Cu@cross-linked poly(vinyl alcohol) microcables. (a) emission spectra. The excitation wavelength is 360 nm. (b) excitation spectra. The emission wavelength is 450 nm.