

Supporting Information

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**Magnetochromatic Polydiacetylene by Incorporation of Fe₃O₄
Nanoparticles****

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Experimental Section

Material. $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$ (>99%) and $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ (>99%) were purchased from Acros Organics. The diacetylenic monomers, $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_3\text{COOH}$ (97.4%), $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_4\text{COOH}$ (96.7%), and $\text{CH}_3(\text{CH}_2)_{11}\text{CCCC}(\text{CH}_2)_8\text{COOH}$ (95%), were purchased from GFS Chemicals, Inc. Tetrahydrofuran (>99%) was obtained from Sinopharm Chemical Reagent Co. Ltd. Aqueous ammonia solution (25%) was purchased from Jiangsu Tongsheng Chemical Reagent Co. Ltd. Deionized water was produced by Millipore purification system (Elix35+Tank200).

Characterization. The morphologies of nanoparticles and films were characterized by transmission electron microscopy (JEOL, JEM-2010F operated at 200 kV), scanning electron microscopy (Hitachi, FE-SEM S-4800 operated at 1 kV), and fluorescence microscopy (Olympus, BX51). The mesostructure of Fe_3O_4 nanoparticles was characterized using X-ray diffraction (Bruker, D8 ADVANCE and DAVINCI.DESIGN, Cu $K\alpha$ radiation at $\lambda = 0.154$ nm, operated at 40 kV and 40 mA). The thermogravimetric analysis and differential thermal analysis were conducted on Shimadzu DTG-60H by heating the samples at 10 °C/min from room temperature to 1050 °C with nitrogen sweep gas. Fluorescence microscopy was made on an Olympus BX51 microscopy at λ_{ex} of 510-550 nm. The magnetic properties of Fe_3O_4 nanoparticles were characterized by a vibrating sample magnetometer (VSM, Quantum Design, MPMS (SQUID) VSM system) at 300 K. The UV-visible spectra were recorded by UV-3150 from Shimadzu. The facility used to produce AC magnetic fields was detailed elsewhere (*J. Magn. Magn. Mater.* **2007**, *311*, 228-233).

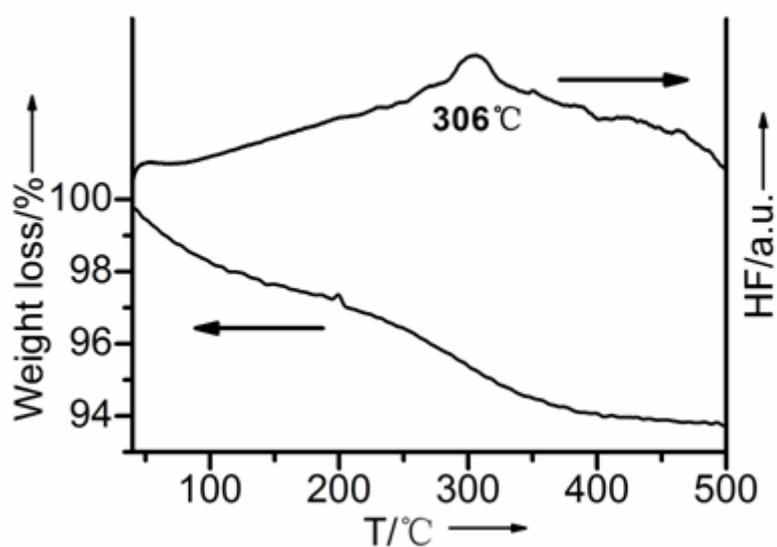


Figure S1. The thermogravimetric analysis (bottom graph) and differential thermal analysis (top graph) of the as-synthesized pure Fe_3O_4 nanoparticles without introduction of diacetylenic precursors. The weight loss of $\sim 2.47\%$ is mainly attributed to evolution of physically adsorbed water below $200\text{ }^\circ\text{C}$, while the weight loss of $\sim 3.44\%$ is due to the reaction of hydroxide groups above $200\text{ }^\circ\text{C}$. Therefore, the average weight content of hydroxide groups is calculated to be about 6.5% .

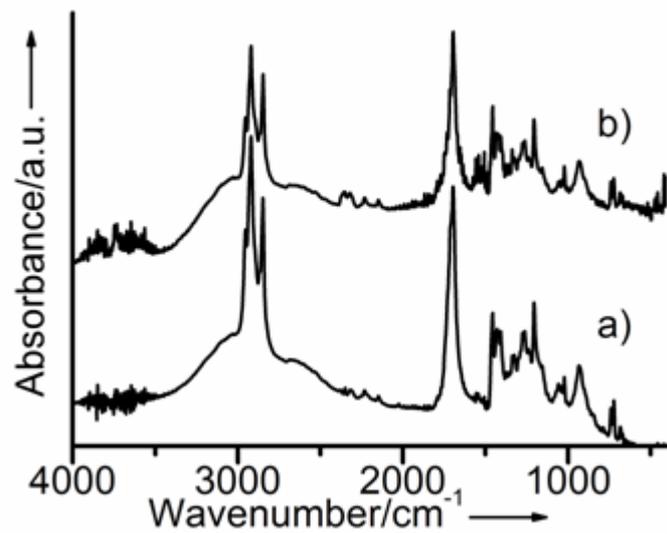
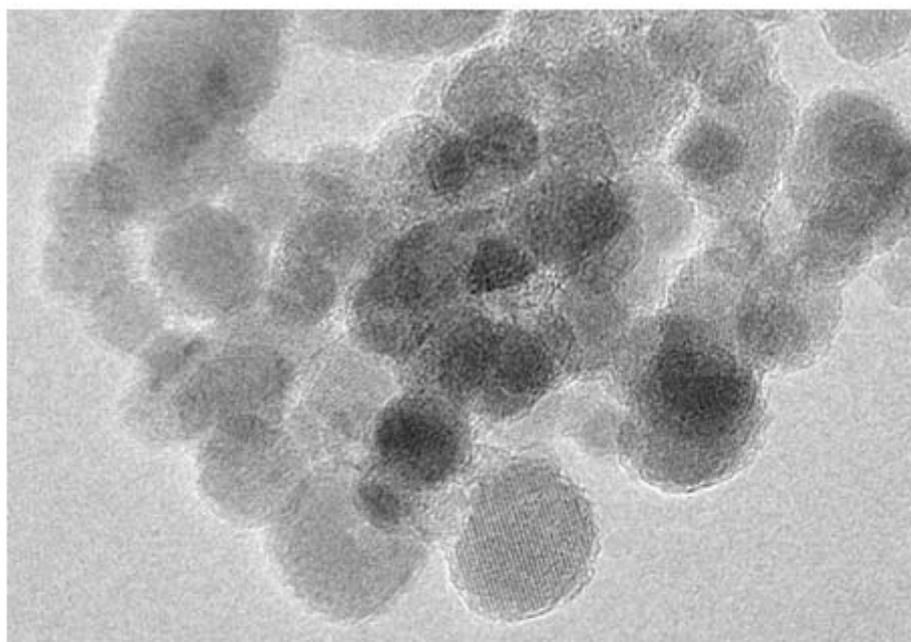
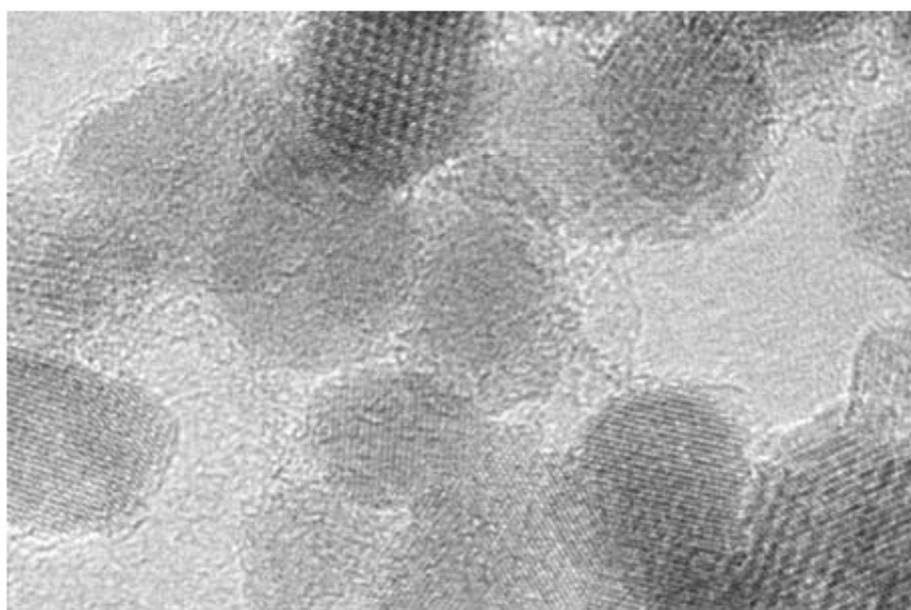


Figure S2. Fourier transform infrared spectra of a) $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_3\text{COOH}$ and b) the complexes of $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_3\text{COOH}$ and Fe_3O_4 nanoparticles.



10 nm



10 nm

Figure S3. TEM images showing that PDA molecules are connected to the outer surfaces of pure Fe_3O_4 nanoparticles through hydrogen bonds.

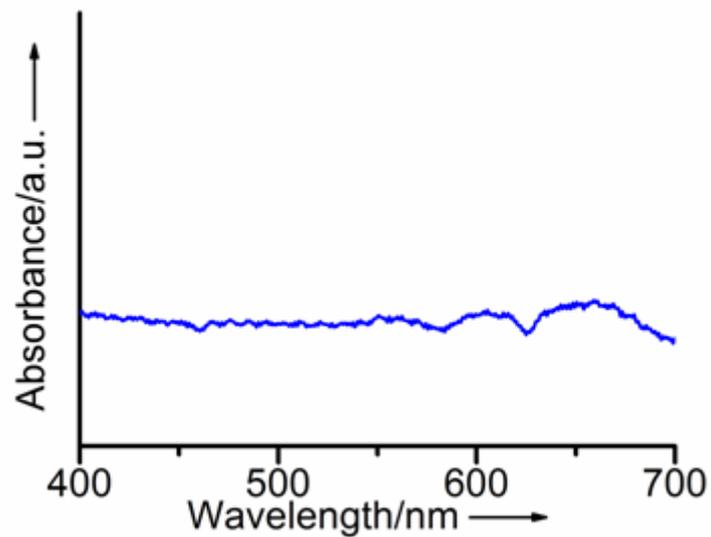


Figure S4. The typical UV-vis spectrum for the composite films derived from $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_4\text{COOH}$ and $\text{CH}_3(\text{CH}_2)_{11}\text{CCCC}(\text{CH}_2)_8\text{COOH}$ at weight ratios of PDA to Fe_3O_4 nanoparticles between 10/1 and 100/1. No color changes had been detected for the blue composite films after exposure to AC magnetic field (55 kHz, 15kA/m).

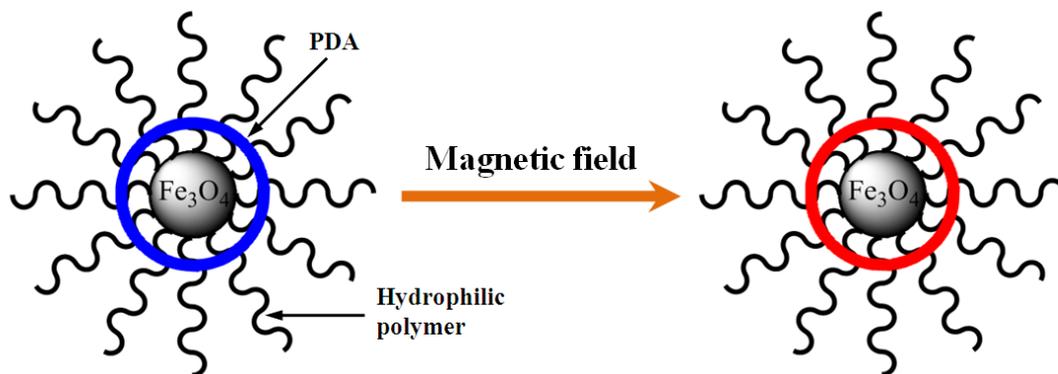


Figure S5. Schematic illustration to the structure of a PDA/Fe₃O₄ nanoparticle stabilized by hydrophilic polymer chains as well as the magnetochromatic transition in aqueous solution. The blue and red colors in the middle shell represent the PDA before and after color change, respectively.

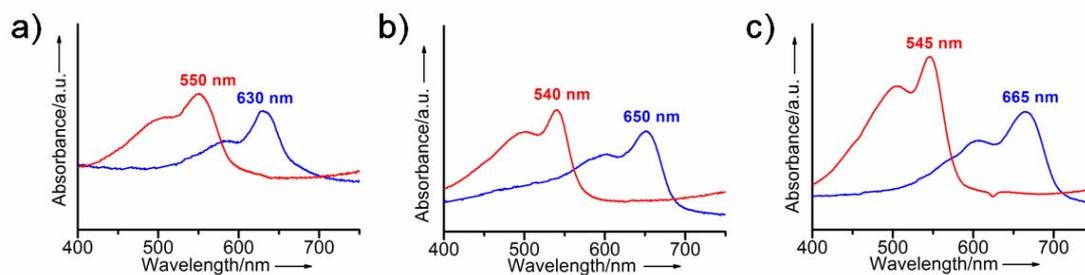


Figure S6. UV-vis spectra of PDA nanomaterials derived from the three monomers of a) $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_3\text{COOH}$, b) $\text{CH}_3(\text{CH}_2)_9\text{CCCC}(\text{CH}_2)_4\text{COOH}$, and c) $\text{CH}_3(\text{CH}_2)_{11}\text{CCCC}(\text{CH}_2)_8\text{COOH}$. The blue and red lines represent the PDA nanomaterials before and after chromatic transitions under environmental stimuli, respectively. The blue and red numbers correspond to the peak wavelengths.