

# Supplementary Information

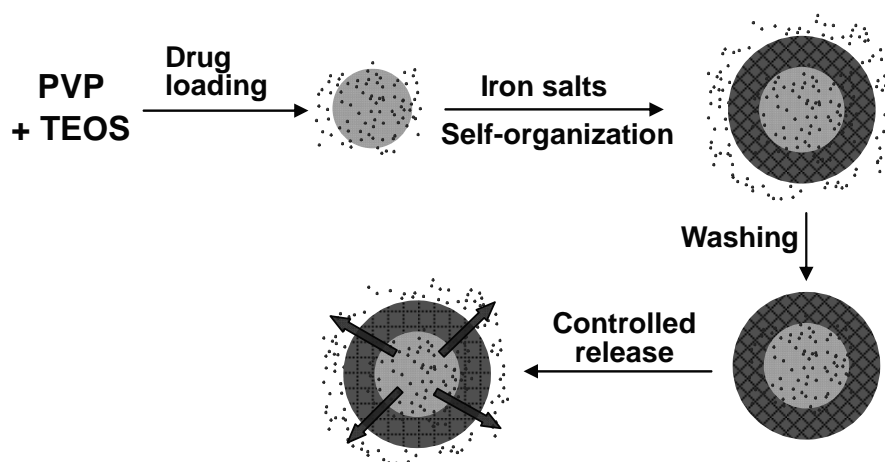
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## Novel Silica Core- Single Crystal Fe<sub>3</sub>O<sub>4</sub> Shell Nanospheres with Magnetically-Triggered Drug Delivery through A Nano-Earthquake-like Mechanism

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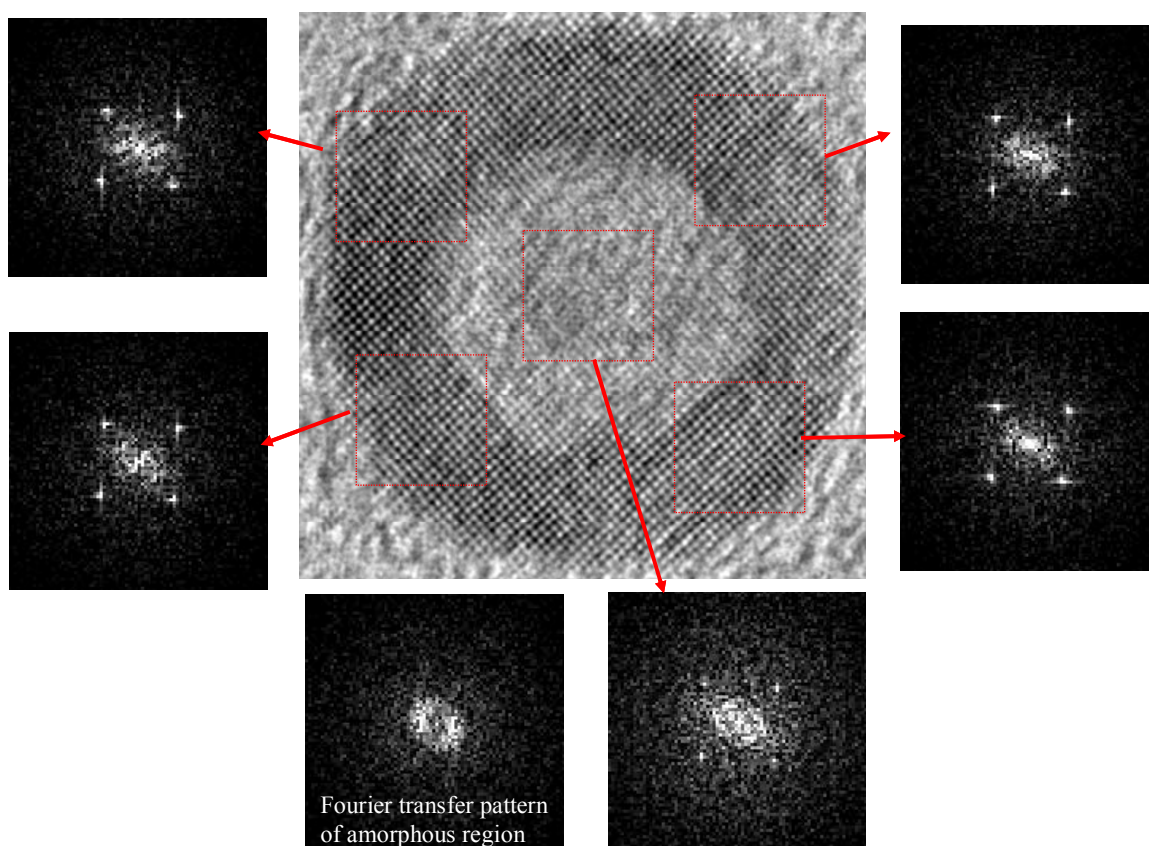
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The use of silica cores allows an efficient encapsulation of the therapeutic molecules or biological molecules to be achieved using a low-temperature sol-gel chemical route. Surface coating with a dense layer of iron oxide shell on the silica core becomes critical. To achieve the goal, a small amount of poly-(N-vinyl-2-pyrrolidone) (PVP) was used to form a molecularly thin layer on the surface of the silica core, and then, the iron oxide salts, dissolved in the water/alcohol mixture, were titrated into the PVP-coated silica core to form the final iron oxide shell. The iron oxide shell demonstrated a surprisingly high restriction of molecular diffusion from the silica core and in the meantime also played a critical role upon magnetically controlled drug release.

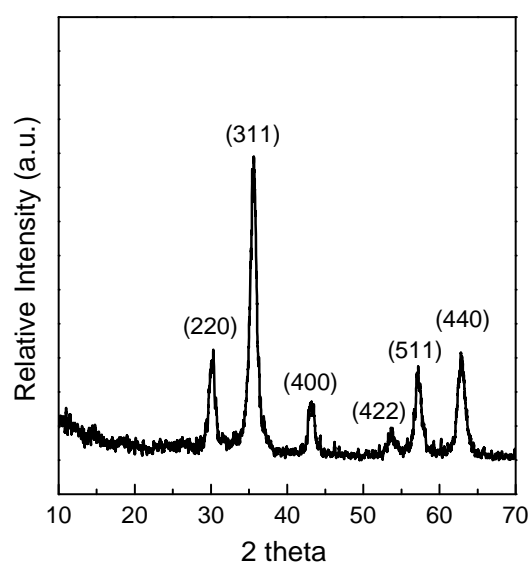


**Figure S1** Schematic of the stimuli-responsive delivery system (PVP-modified Silica/Fe<sub>3</sub>O<sub>4</sub> core-shell nanospheres) based on silica-PVP nanospheres coated with iron oxide shells. The controlled release of PVP-modified Silica/Fe<sub>3</sub>O<sub>4</sub> core-shell nanospheres is based on

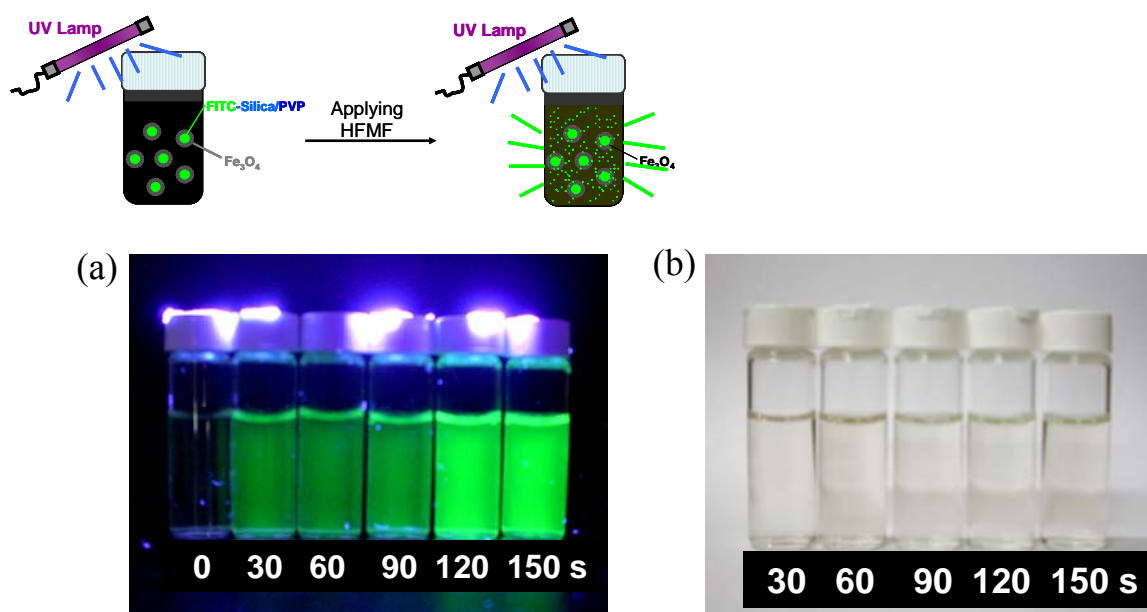
applying high-frequency magnetic field (HFMF).



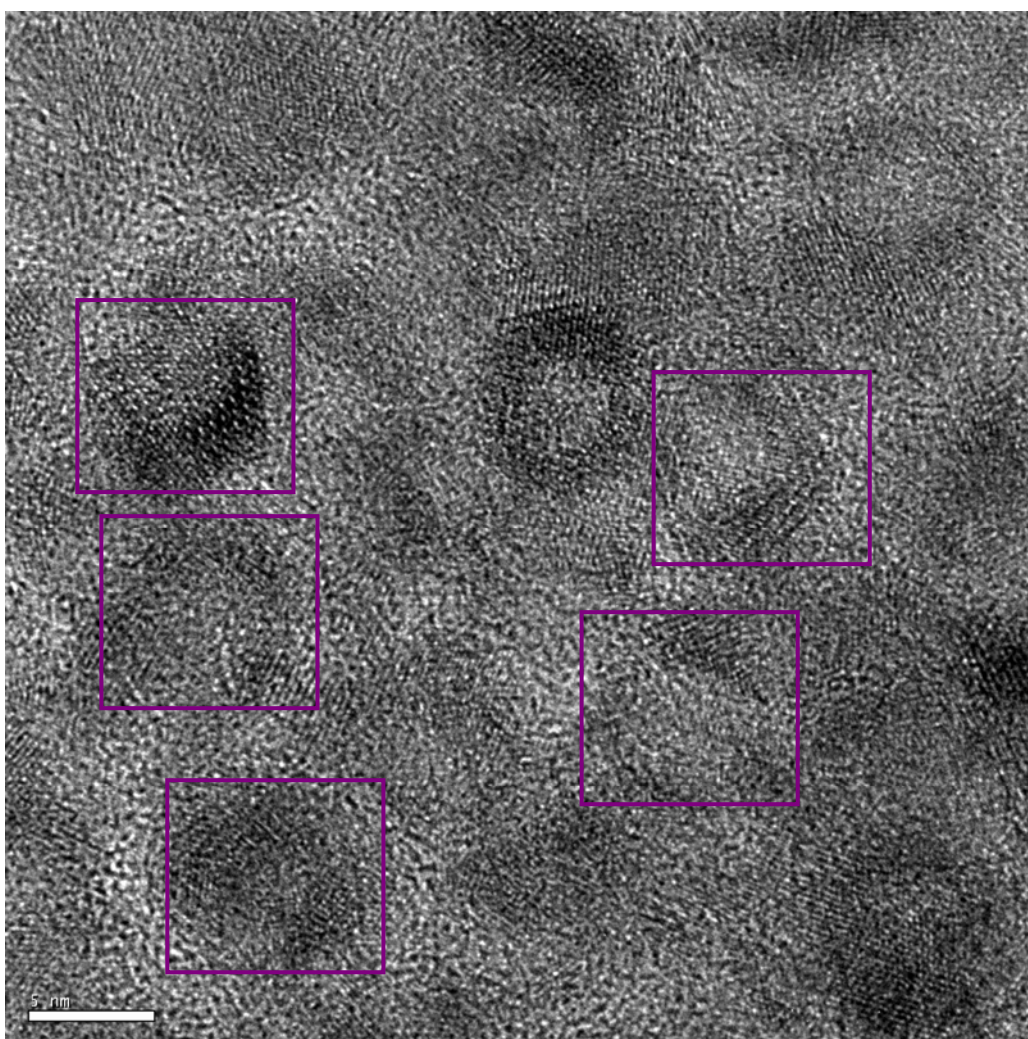
**Figure S2** Local Fourier transfer patterns indicate that the crystalline is uniform and homogenous through the particle.



**Figure S3** X-ray diffractometer verified the crystallographic phase, at a scanning rate of 6° 2θ per minute, as Fe<sub>3</sub>O<sub>4</sub> (magnetite, according to JCPDS [85-1436]).<sup>(1)</sup>



**Figure S4** Photographs of the cuvettes with fluorescence-loaded PVP-modified Silica/Fe<sub>3</sub>O<sub>4</sub> core-shell nanospheres dispersed in water solution. (a) 0.3 wt% of PVP-modified Silica/Fe<sub>3</sub>O<sub>4</sub> core-shell nanospheres for applying HFMF with different time: (a) under UV light, (b) visible light.



**Figure S4** TEM images of long-term HFMF exposure, the nano-faults received sufficient amount of the energy, vigorous energy (although not specifically identified yet in this communication) ruptures the thin shell permanently.

(1) Long, J. W.; Logan, M. S.; Rhodes, C. P.; Carpenter, E. E.; Stroud, R. M.; Rolison, D. R. *J. Am. Chem. Soc.* **2004**, *126*, 16879.