Supporting Information

to

Synthesis and properties of core-shell fluorescent hybrids with distinct morphologies based on carbon dots

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Purification of the biogenic magnetite nanoparticles: The magnetosome phospholipid membrane and associated organic debris from the magnetic cores was removed with NaOH. More specifically, magnetosomes dispersed in water (approximately 1 mg mL^{-1}) were magnetically collected, re-dispersed in the same volume of 5M NaOH and incubated at 98 °C for 30 minutes. Then, the magnetic fraction was collected with an external magnet and washed three times with deionized water.

Capillary electrophoresis (CE): All of the measurements were performed on the capillary electrophoresis system Agilent HP 3DCE with diode array detector (Agilent Technologies, Waldbronn, Germany) and laser-induced fluorescence detector (Picometrics, Toulouse,

France) operating at an excitation wavelength of 488 nm. Uncoated fused silica capillaries (MicroSolv Technology, Eatontown, NJ, USA) with 50 μm i.d., total capillary length of 75 cm, and effective length of 60 cm were used in these experiments. The capillary cassette was thermostated at 25 °C. The capillary was rinsed with 0.5 M NaOH (2 min), deionized water (3 min), and buffer (5 min) before each analysis by a pressure drop of 925 mbar. Applied voltage was + 20 kV. All of the measurements were performed in triplicates. Electrolytes were prepared as follows: appropriate amount of 3-(N-morpholino)propanesulfonic acid (MOPS) were dissolved in deionized water (18 MΩ cm, Millipore, Billerica, MA, USA) and the pH was adjusted using sodium hydroxide. Ionic strength of both buffers was 10 mM.

TEM: TEM images were obtained using a JEM2010 microscope operated at 200 kV with a point-to-point resolution of 1.9 Å. Before measurements, samples were dispersed in ethanol and the suspension was treated in ultrasound for 10 minutes. A drop of a very dilute suspension was placed on a carbon-coated grid and allowed to dry by evaporation at room temperature.

Magnetic characterization: A superconducting quantum interference device (SQUID, MPMS XL-7 type Quantum Design) was used for magnetic measurements. The hysteresis loops of all samples were collected at a temperature of 300 K in external magnetic fields ranging from – 70 to + 70 kOe.

HRTEM (EDS): HRTEM images were recorded on a Titan G2 80–200 transmission electron microscope with a ChemiSTEM Technology (X-FEG, accelerating voltage of 200 kV). A drop of the sample, dispersed in deionized water, was place onto the copper grid with holey carbon film and air-dried at room temperature. EDX chemical maps were recorded at 200 kV for 180 s with 0.6 nA beam current, 50 dwell time and M = 910 k.

Stem cell cultures and their labeling: Rat mesenchymal stem cells were isolated from a bone marrow of femurs. The cell suspension was filtered through a 40-μm nylon filter (Falcon) and plated in plastic chambers. Cells were grown in Iscove's Modified Dulbecco's Medium (IMDM; Invitrogen) with 10% fetal bovine serum (FBS) and 2% penicilin/streptomycin (PS) at 37 °C under 5% CO_2. After 24 hours, the medium was replaced to remove non-adhered cells. The cells were grown to obtain 80 % of confluence. Cells were incubated with 100 μL of MagQCDs suspension containing 400 μg of MagQCDs per mL. After 72 hours of incubation, the cells were imaged by optical and fluorescence microscopy. All animal experiments were performed in accordance with the Czech Guide for the Care and Use of Laboratory Animals and were approved by the Committee for the Use of Experimental Animals at the Masaryk University in Brno in the Czech Republic.

Supporting Figures

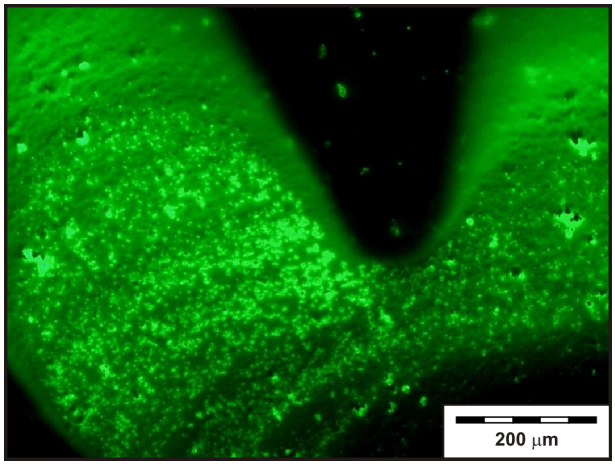

Fig. S1. Pristine QCDs under the fluorescence microscope.

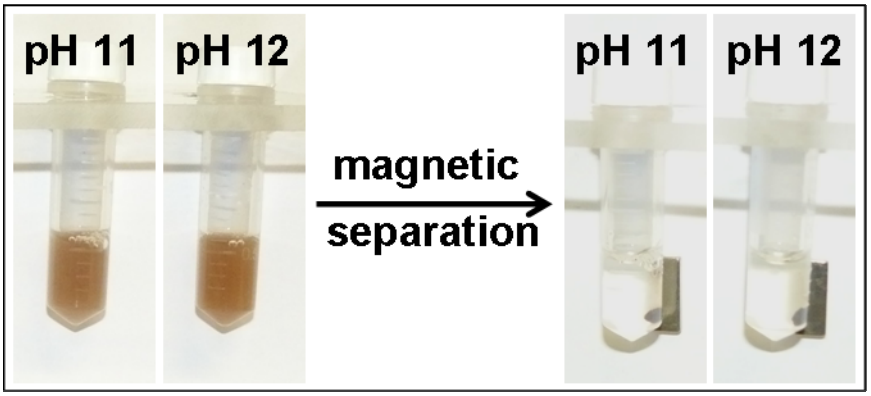

Fig. S2. The MagQCDs (QCDs/Mag = 1) prepared at pH of 11 and 12 in the absence (left) and presence (right) of an external magnet. The complete discoloration of the aqueous phase on the right suggests a strong magnetic response.

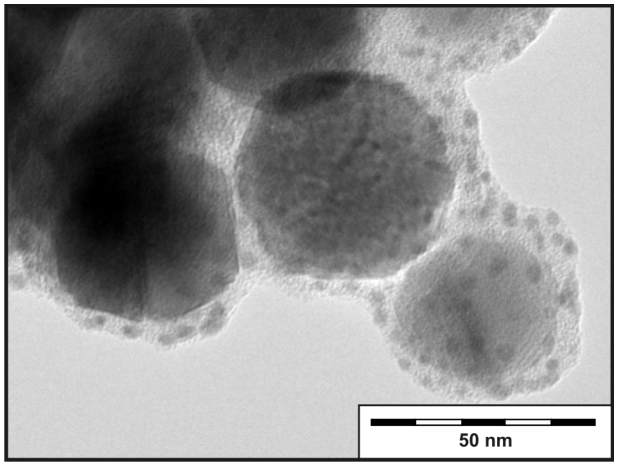

Fig. S3. TEM image of MagQCDs (QCDs/Mag = 1) prepared at pH = 11.

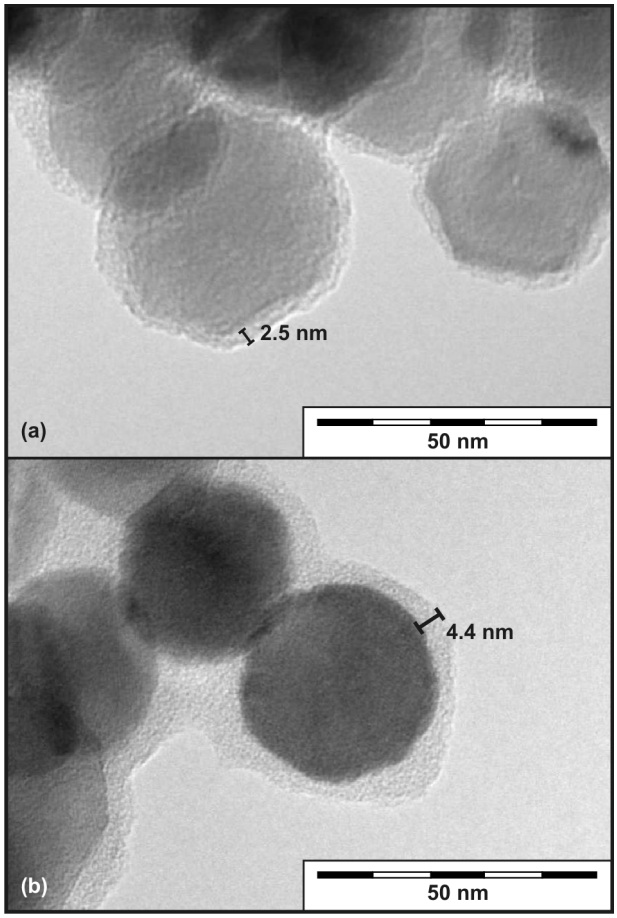

Fig. S4. TEM images of MagQCDs prepared at pH = 12 with different QCDs loading, which is reflected in different shell thicknesses: (a) QCDs/Mag = 1 and (b) QCDs/Mag = 5.

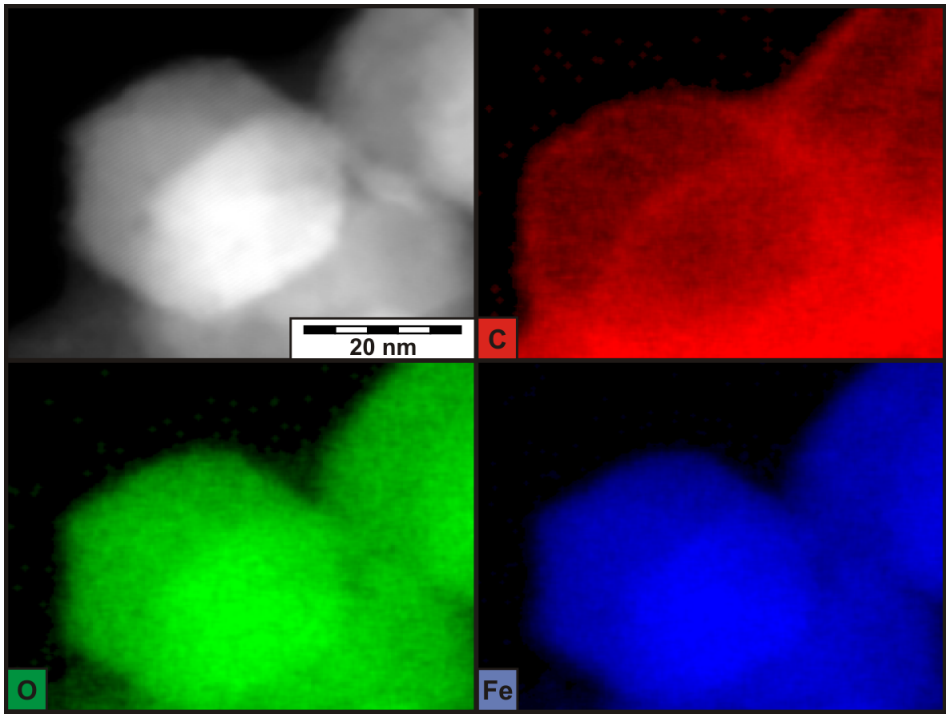

Fig. S5. HRTEM images combined with EDX chemical mapping of the MagQCDs hybrid nanoparticles prepared at pH = 12 demonstrating the presence of carbon-based species coverage on the surface of magnetite (red image).

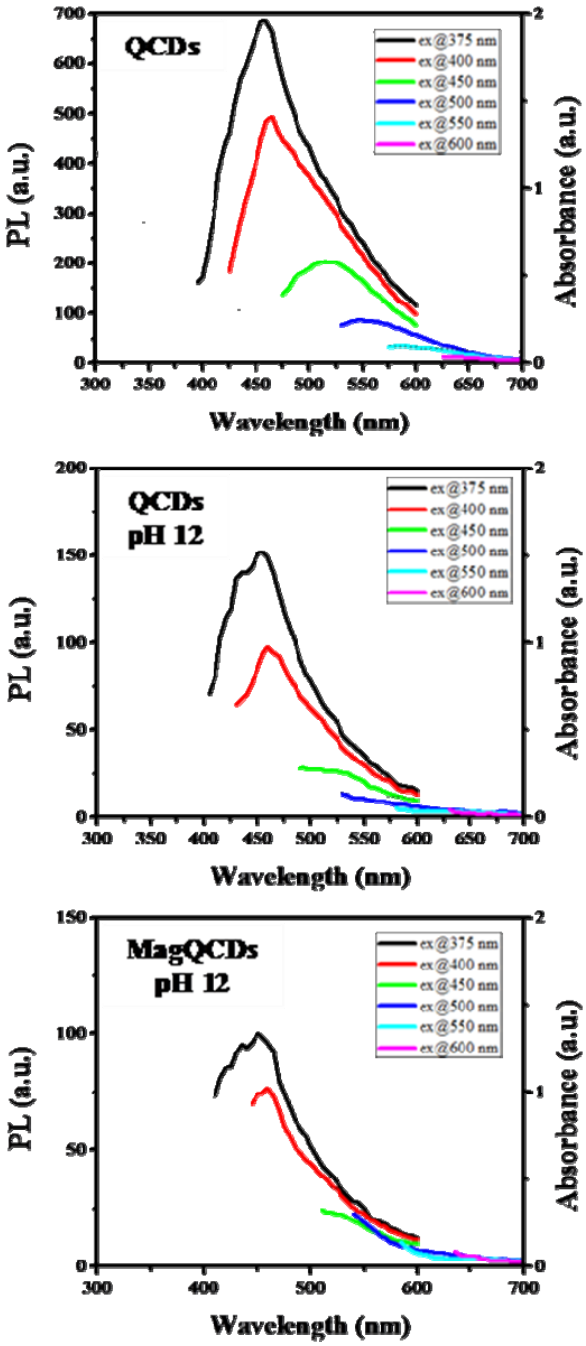

Fig. S6. Absorption and wavelength-dependent emission spectra of pristine QCDs (top), QCDs treated at pH = 12 (middle) and MagQCDs (QCDs/Mag = 1) synthesized at pH = 12 and re-dispersed in water at pH = 7 (bottom).

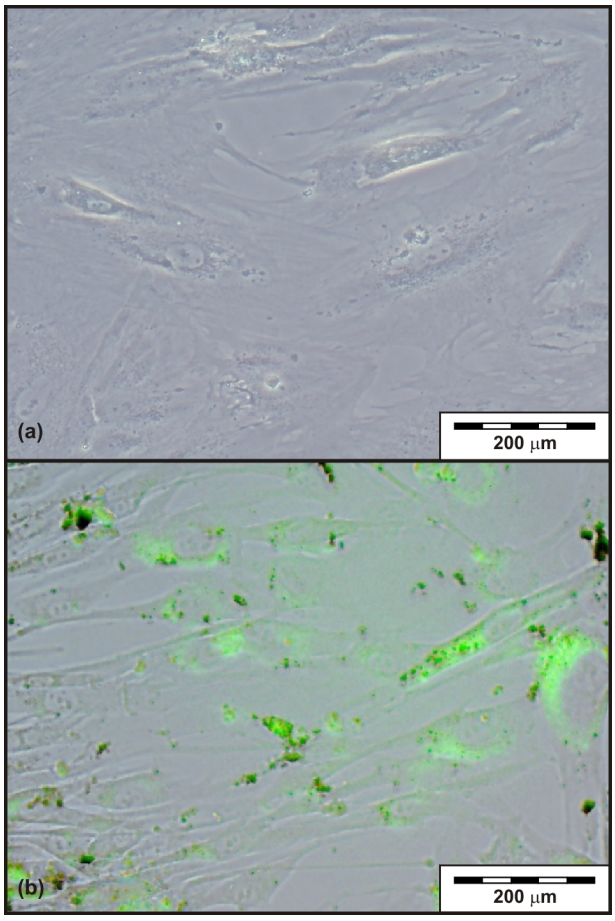

Fig. S7. In-vitro stem cell labeling (original magnification x400): (a) unlabeled MSCs and (b) MSCs labeled with MagQCDs. QCDs/Mag = 1; time of incubation 72 hours (phase contrast combined with fluorescence mode).

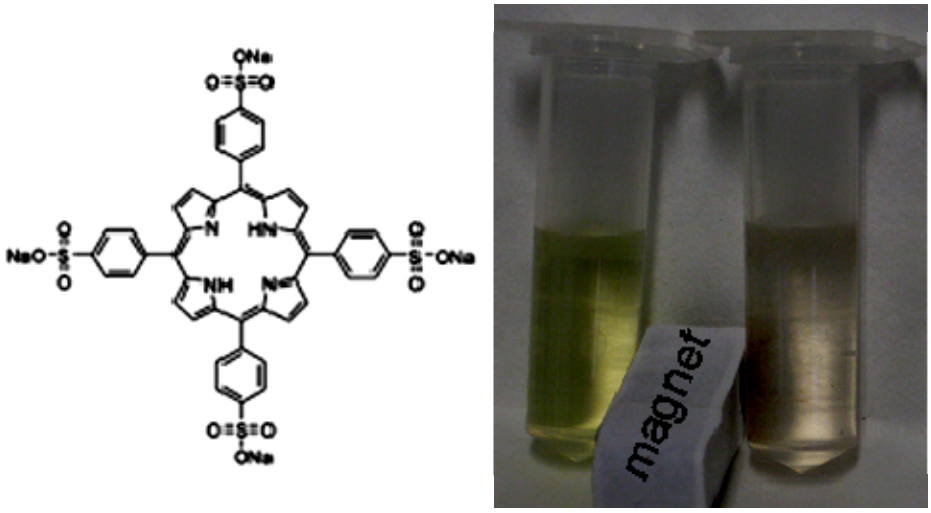

Fig. S8. Ion exchange properties of MagQCDs. The Eppendorf tube on the left-side of the photo shows a yellow aqueous solution of the anionic porphyrin (10^{-5} M). The Eppendorf tube on the right-side of the photo shows the same solution in the presence of MagQCDs after applying an external magnetic field.