Supporting Information

PEG-mediated synthesis of highly dispersive multifunctional superparamagnetic nanoparticles: their physiochemical properties and function *in vivo*

Conroy Sun[1], Kim Du[2], Chen Fang[1], Narayan Bhattarai[1], Omid Veiseh[1], Forrest Kivit[1], Zachary Stephen[1], Donghoon Lee[3], Richard G. Ellenbogen[4,5], Buddy Ratner[2], and Miqin Zhang[1,3,4] *

[1]*Department of Materials Science & Engineering, University of Washington, Seattle, Washington 98195, USA*

[2] *Department of Bioengineering, University of Washington, Seattle, Washington 98195, USA*

[3] *Department of Radiology, University of Washington, Seattle, Washington 98195, USA*

[4] *Department of Neurological Surgery, University of Washington, Seattle, Washington 98195, USA*

[5] *Seattle Children's Hospital & Regional Medical Center, Seattle, Washington 98105, USA*

*Miqin Zhang, Ph.D
Department of Materials Science & Engineering
302L Roberts Hall
University of Washington
Seattle, WA 98195-2120,
Phone: (206) 616 9356
Fax: (206) 543 3100
E-mail: mzhang@u.washington.edu

1. Transmission electron microscopy

The size and morphology of the ION/PEG cores were evaluated by transmission electron microscopy (TEM). TEM grids were prepared by depositing a drop of diluted nanoparticle suspension on 300 mesh silicon-monoxide support films and drying the grids under vacuum for 2 hrs. TEM images were acquired on a Phillips 400 TEM operating at 100 KV.

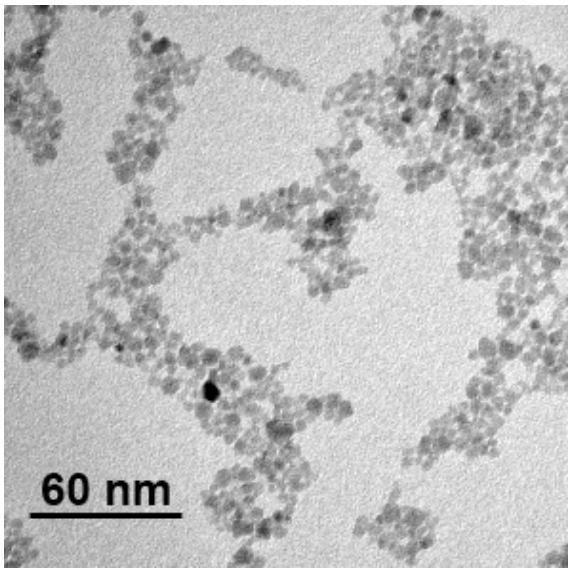

Figure S1. TEM image of the ION/PEG nanoparticles.

The crystalline core of the nanoparticles ranged from 4 to 8 nm in diameter with a spherical shape. The hydrodynamic size of the ION/PEG in PBS was then determined by dynamic light scattering (DLS) and found to be ~13.5 nm (Figure 2A). Assuming a mean core diameter of 6 nm, a coating thickness of ~3.75 nm corresponds well to the estimated length of the end-grafted PEG chain attached to the nanoparticle surface.

2. Long-term stability of ION/PEG in PBS

The stability of nanoparticles produced by the PEG-mediated synthesis method was evaluated by monitoring the hydrodynamic size of the nanoparticles in PBS over time. DLS measurements were acquired immediately after synthesis and after 1 and 6 months storage at 4°C (Figure S1). Although the shape of the distribution curve change slightly over time, the mean diameter remained consistent at approximately 13.5 nm over the entire course of the evaluation period suggesting that the nanoparticles are stable under these conditions.

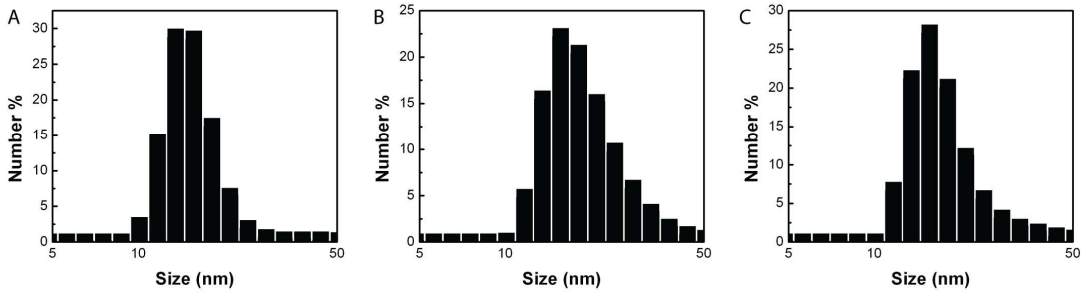

Figure S2. Nanoparticle stability based on hydrodynamic size change in PBS over time. Size distribution of nanoparticles (A) immediately after synthesis, (B) 1 month and (C) 6 months after synthesis.

3. X-ray photoelectron spectroscopy (XPS) analysis of ION/PEG

ION/PEG was lyophilised (Virtis Freezemobile) to remove water from samples for analysis. XPS experiments on the powder samples were carried out at the National ESCA and Surface Analysis Center for Biomedical Problems (NESAC/BIO) at the University of Washington (Seattle, Washington). XPS spectra were obtained using a Surface Science Instrument X-probe spectrophotometer with a monochromatized Al X-ray source and 5 eV flood gun for charge neutralization (Figure 2S). The x-ray spot size for the acquisition was on the order of 800 μm.

Pressure in the analytical chamber during spectral acquisition was less than 5×10^{-9} Torr. The take-off angle was 55°.

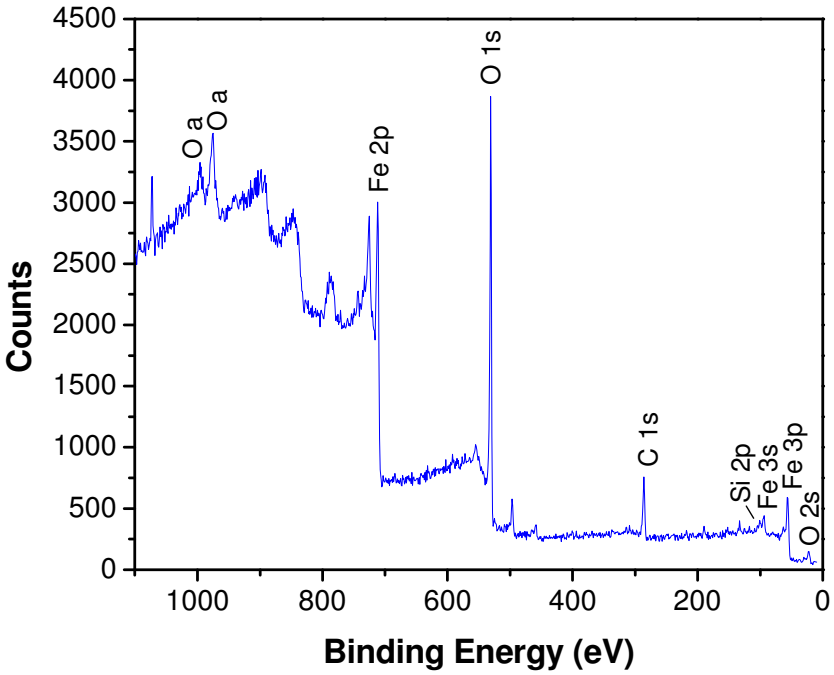

Figure S3. XPS survey scan of ION/PEG. The presence of silane anchored PEG to the iron oxide surface was confirmed by the atomic composition of the sample displaying 22.0% carbon, 53.6% oxygen, 3.0% silicon and 14.3% iron.