Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is  $\ensuremath{\mathbb{O}}$  The Royal Society of Chemistry 2013

Supporting information

# Neuronal cells loaded with PEI-coated Fe<sub>3</sub>O<sub>4</sub> nanoparticles for magnetically-guided nerve regeneration

M.Pilar Calatayud,<sup>a\*</sup> Cristina Riggio,<sup>\*b</sup>Vittoria Raffa,<sup>b</sup> Beatriz Sanz,<sup>a</sup> Teobaldo E. Torres,<sup>a,c,d</sup> M. Ricardo Ibarra,<sup>a,c</sup> Clare Hoskins,<sup>e</sup> Alfred Cuschieri,<sup>e</sup> Lijun Y. Wang,<sup>e</sup> J. Pinkernelle,<sup>f</sup>Gerburg Keilhoff<sup>f</sup> and Gerardo F. Goya<sup>a,c</sup>

<sup>a</sup>Instituto de Nanociencia de Aragón, Universidad de Zaragoza, 50018 Zaragoza, Spain

<sup>c</sup>Departamento de Física de la Materia Condensada, Universidad de Zaragoza, 50009 Zaragoza, Spain

<sup>d</sup>Laboratorio de Microscopias Avanzadas (LMA), Universidad de Zaragoza, 50018 Zaragoza, Spain

<sup>e</sup>Institute for Medical Science and Technology, University of Dundee, DD21FD Dundee, UK

<sup>f</sup>Otto-von-Guericke University, Institute of Biochemistry and Cell Biology, D-39120 Magdeburg, Germany.

<sup>\*</sup>These authors contributed equally to this work.

<sup>&</sup>lt;sup>b</sup>Scuola Superiore Sant'Anna, Piazza Martiri della Libertà 33, 56127 Pisa, Italy

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is O The Royal Society of Chemistry 2013



*Figure S1. Hydrodynamic diameter distribution of PEI-coated MNPs as obtained from the DLS measurements.* 



*Figure S2. Fine scanning of the XPS spectrum for the energy window showing the peaks corresponding to the Fe 2p core-level signals from PEI-MNPs.* 

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is  $\ensuremath{\mathbb{O}}$  The Royal Society of Chemistry 2013



*Figure S3. Zeta potential values vs. pH for naked (circles) and PEI-coated (filled squares) magnetic nanoparticles. The lines are only a guide for the eye.* 



**Figure S4.** TGA curves of naked MNPs (solid line) and PEI-MNPs (dashed line) under N<sub>2</sub> atmosphere. The TGA data of pure PEI polymer obtained under the same conditions (doted-dash line) is also shown for comparison.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is The Royal Society of Chemistry 2013



*Figure S5.* ATR-IR spectra of (a) PEI polymer, (b) PEI-MNPs. The arrows mark the position for the characteristics peaks of PEI and (c) naked-MNPs.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is O The Royal Society of Chemistry 2013



**Figure S6.** Magnetic data obtained from the frozen colloids: (a) Hysteresis loops taken at T = 10 and 250 K of PEI-MNPs. The inset shows a magnification of the curves at low field. (b) Magnetization vs. temperature curves obtained in zero-field and field-cooling modes. Samples were cooled down to T = 5 K and measured with increasing T in a constant field of H = 100 Oe.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B This journal is O The Royal Society of Chemistry 2013



**Figure S7.** Representative SEM/FIB image on SH-SY5Y cells showing the presence of (i) MNPs agglomerates attached to the cell membrane. (ii) Analysis of transversal slices performed by ion milling confirmed the presence of PEI-MNPs clusters within the cytoplasm. The cells were cultured (24 h with 5ug/mL PEI/MNPs) and washed several times before fixing. Elemental analysis by EDX spectra (right panels (i) and (ii) of target areas confirmed the Fe content expected for the PEI-MNPs core.