Supporting Information

Improvement of hyperthermia properties of iron oxide nanoparticles by surface coating

Marta Vassallo†‡, Daniele Martella†⸸, Gabriele Barrera†, Federica Celegato†, Marco Coïsson†, Riccardo Ferrero†, Elena S. Olivetti†, Adriano Troia†, Hüseyin Sözeri⁑, Camilla Parmeggiani⁘⸸, Diederik S. Wiersma⁂⸸, Paola Tiberto†, Alessandra Manzin†*

†Istituto Nazionale di Ricerca Metrologica (INRiM), Department of Advanced Materials Metrology and Life Science, Strada delle Cacce 91, 10135 Torino, Italy

‡Politecnico di Torino, Dipartimento di Elettronica e Telecomunicazioni, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

⸸University of Florence, European Laboratory for Non-Linear Spectroscopy (LENS), Via Nello Carrara 1, 50019 Sesto Fiorentino, Italy

⁑TÜBİTAK Ulusal Metroloji Enstitüsü (UME), Magnetics Laboratory, Gebze Yerleşkesi, 41470 Kocaeli, Turkey

∴University of Florence, Department of Chemistry "Ugo Schiff", Via della Lastruccia 3-13, 50019 Sesto Fiorentino, Italy

⁂University of Florence, Department of Physics and Astronomy, Via Giovanni Sansone 1, 50019 Sesto Fiorentino, Italy

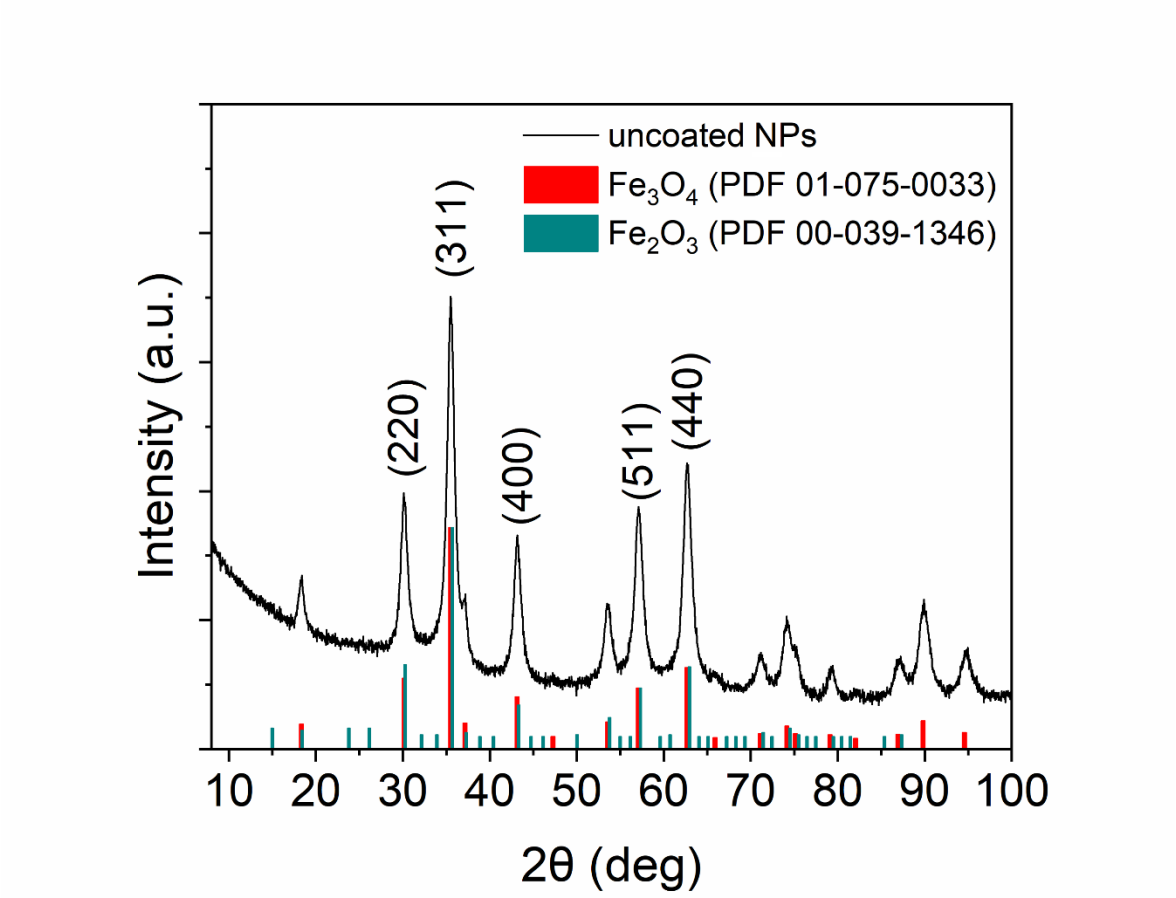

Figure S1. XRD pattern of the uncoated Fe_3O_4 NPs, reporting the square root of the intensities; the characteristic diffraction peaks of Fe_3O_4 (ICDD PDF card No. 01-075-0033) and Fe_2O_3 (ICDD PDF card No. 00-039-1346) are indicated for comparison with the red and green vertical lines, respectively.

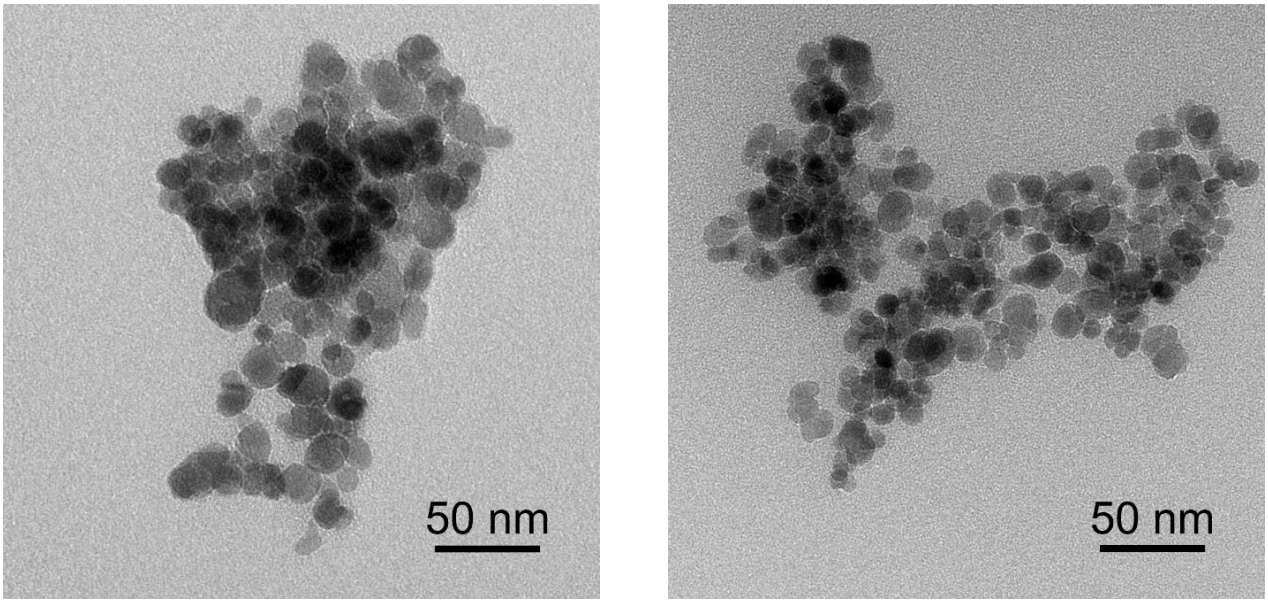

Figure S2. TEM images of CMC-coated Fe_3O_4 NPs.

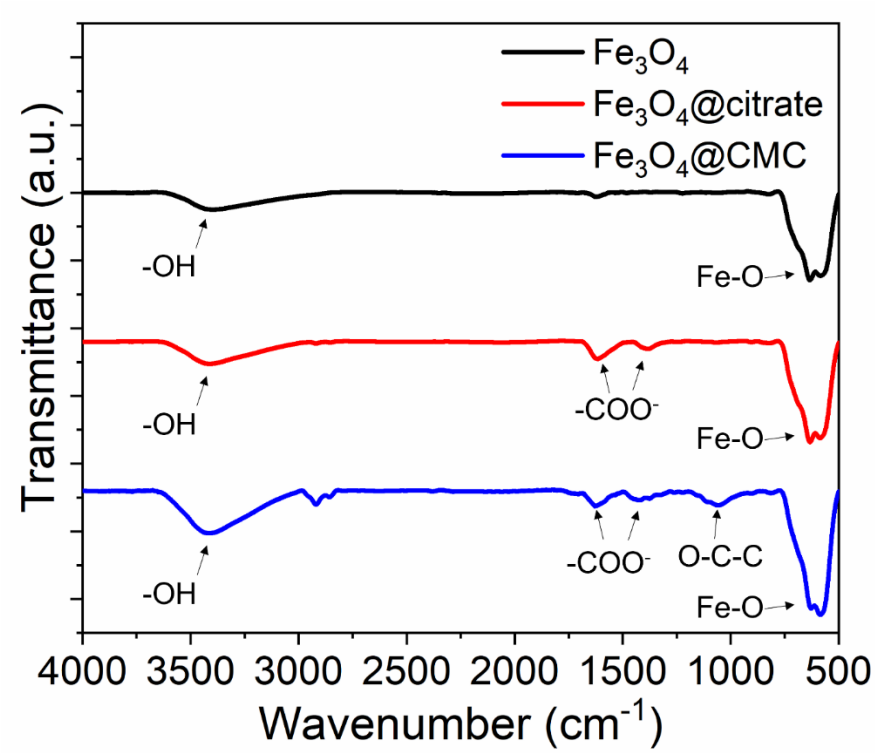

Figure S3. FTIR spectra of Fe_3O_4 NPs (black) and coated NPs with tri-sodium citrate (red) and CMC (blue).

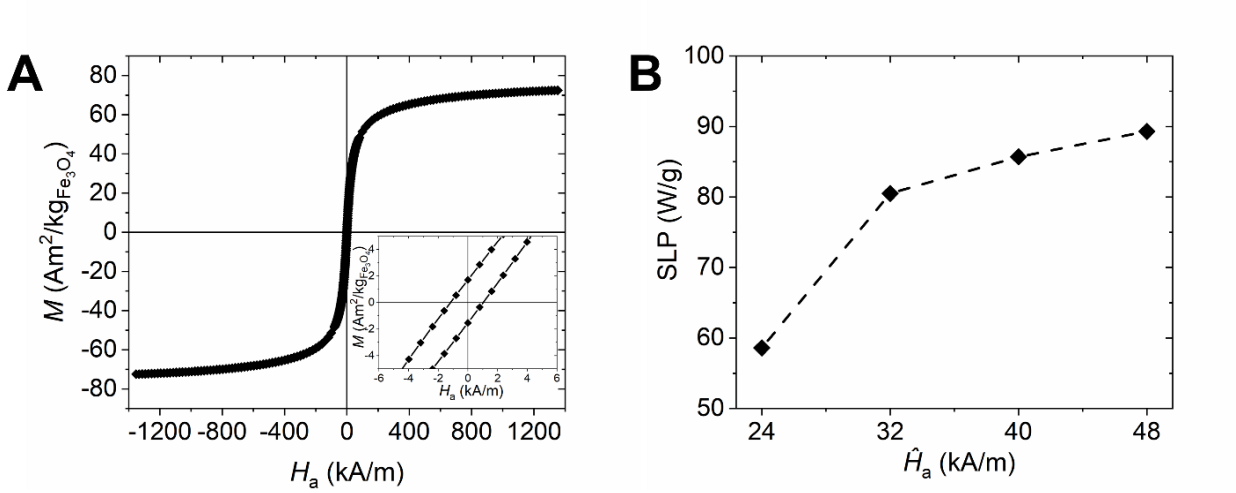

Figure S4. (A) Room-temperature *M(H)* curves and (B) SLP values of an additional uncoated Fe_3O_4 NPs synthesis batch.

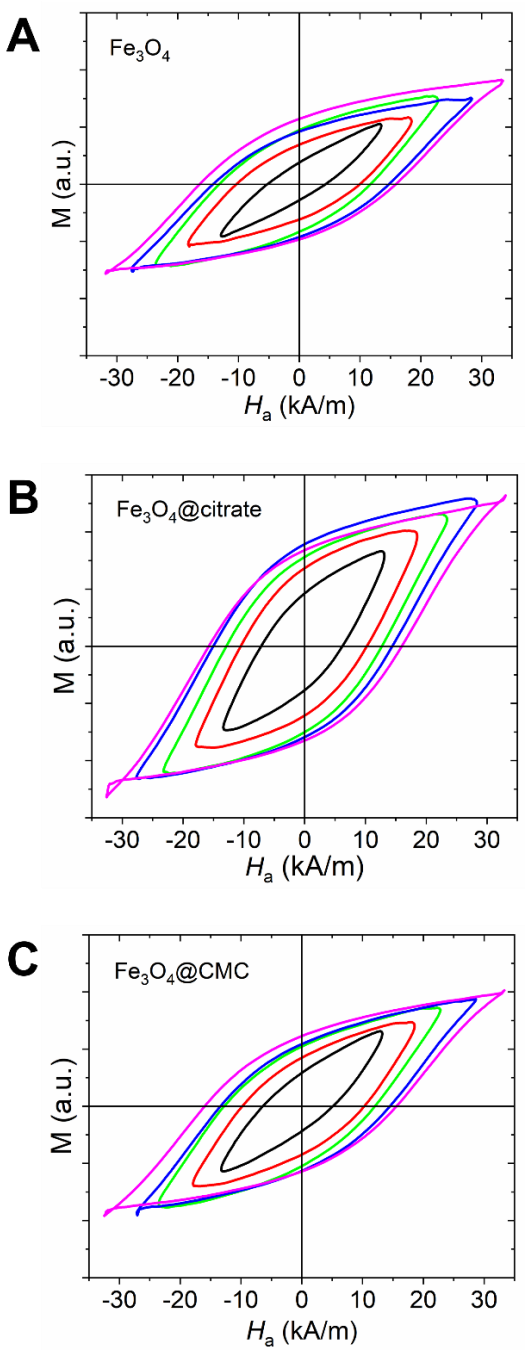

Figure S5. Dynamic hysteresis loops at room temperature of (A) uncoated and coated Fe_3O_4 NPs with (B) tri-sodium citrate and (C) CMC. The measurements were performed on liquid samples at different values of the AC magnetic field peak amplitude ($\hat{H}_a$) in the range 13-32 kA/m, fixing the frequency to 69 kHz. All the hysteresis curves are normalized to the sample mass and reported in arbitrary units with the same inferior and superior limits, to enable direct comparison.

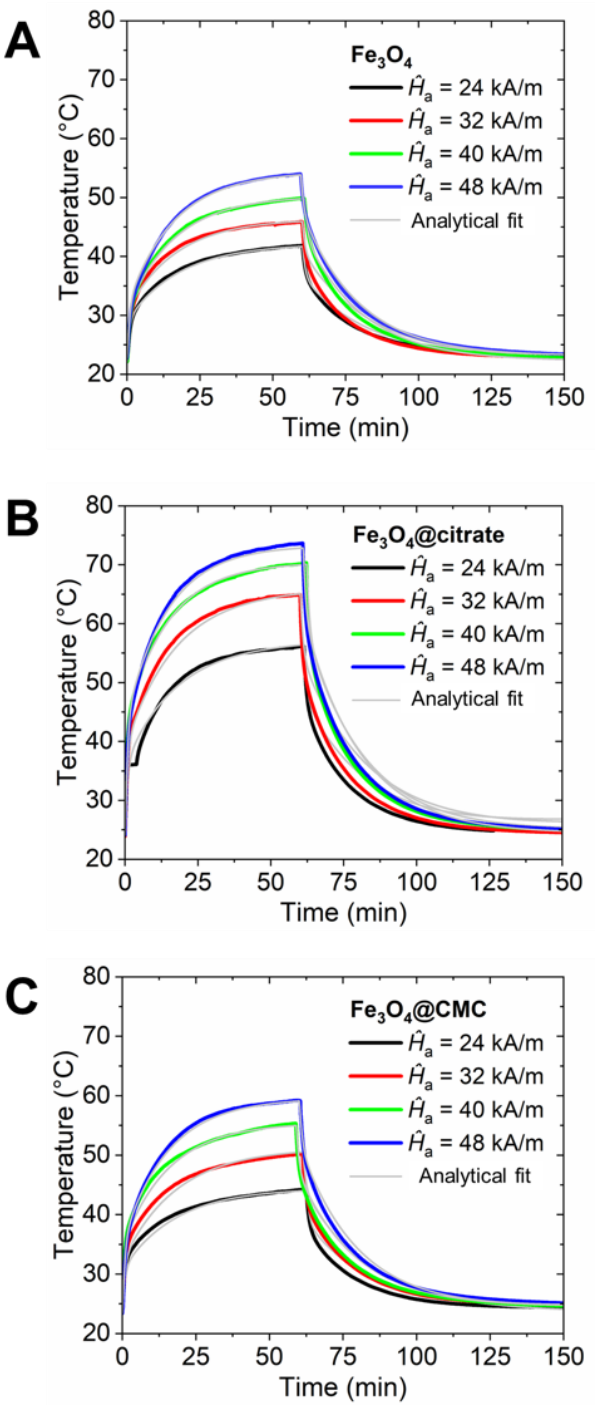

Figure S6. Time evolutions of the temperature of the magnetic suspensions containing (A) the uncoated NPs, (B) the citrate- and (C) CMC-coated NPs following the application of an AC magnetic field with different peak amplitudes variable in the range 24-48 kA/m and frequency fixed to 100 kHz. The graphs contain the experimental data and the best fit outputs of the analytical thermodynamic model.

Table S1. SLP values for uncoated and coated Fe_3O_4 NPs, obtained at different peak amplitudes $\hat{H}_a$ of the AC magnetic field (24-48 kA/m), setting the frequency at 100 kHz.

Sample	$\hat{H}_a$ = 24 kA/m	$\hat{H}_a$ = 32 kA/m	$\hat{H}_a$ = 40 kA/m	$\hat{H}_a$ = 48 kA/m
Fe_3O_4	60.4	82.0	85.0	86.3
Fe_3O_4@citrate	99.8	132.0	164.9	171.3
Fe_3O_4@CMC	50.8	67.8	87.4	97.3