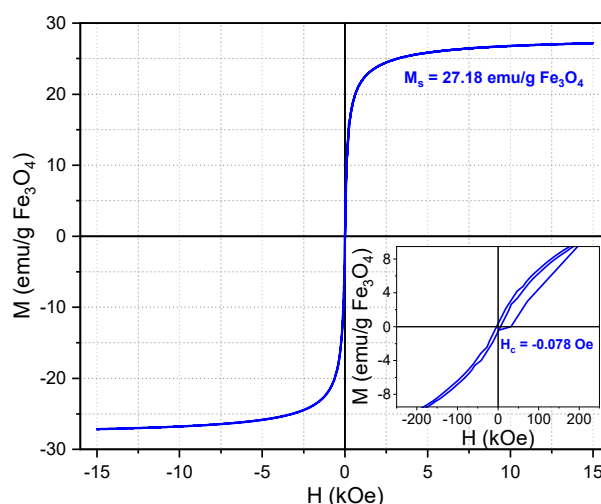


# Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> functionalized nanoparticles as a potential contrast agent in magnetic resonance

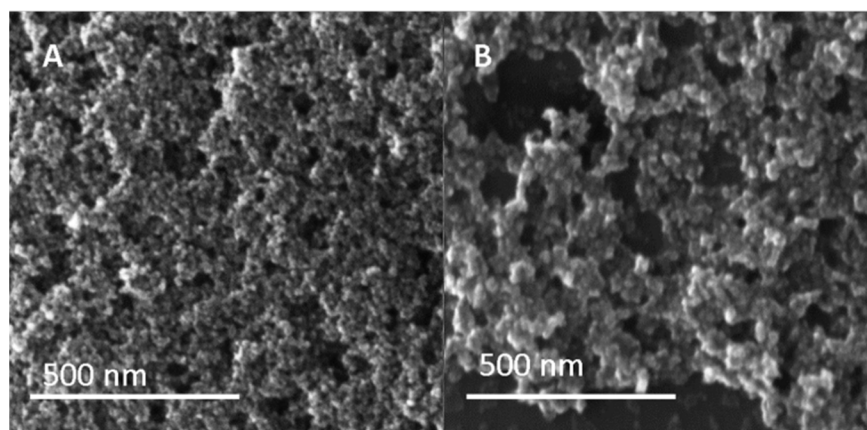
Brayan Stick Betin Bohorquez<sup>1</sup>, Indry Milena Saavedra Gaona<sup>2</sup>, Carlos Arturo Parra Vargas<sup>2</sup>, Karina Vargas-Sánchez<sup>3</sup>, Jahaziel Amaya<sup>1</sup>, Mónica Losada-Barragán<sup>4</sup>, Javier Rincón<sup>1</sup> and Daniel Llamosa Pérez <sup>1,\*</sup>

## Magnetization curves at 300 K of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> during the reheating process

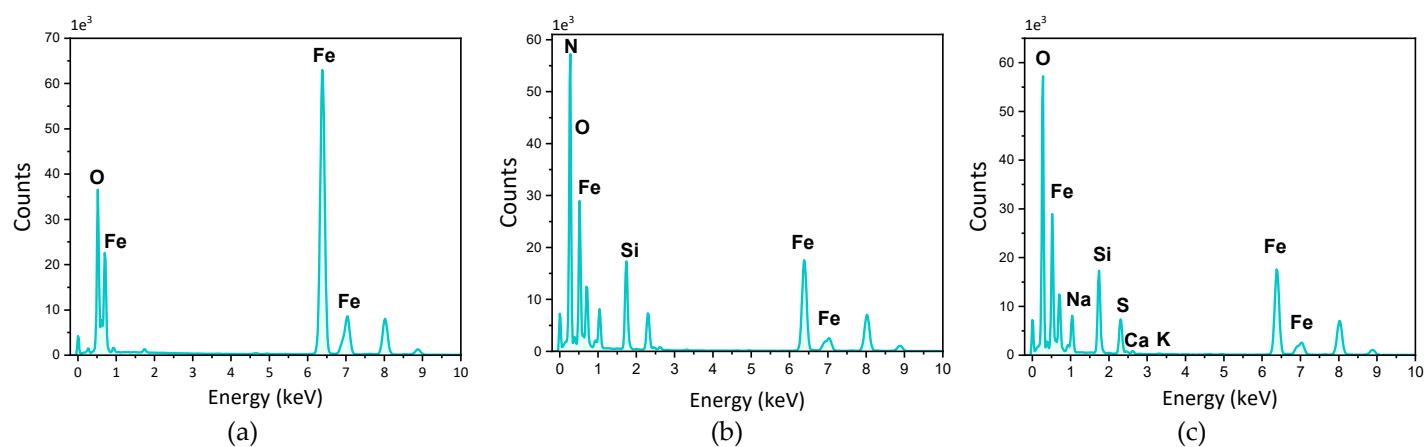
The magnetization of the Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> sample was rescaled using the weight fraction of Fe<sub>3</sub>O<sub>4</sub> in the system. For this adjustment, the weight fraction 0.75261 (75.3%) for Fe<sub>3</sub>O<sub>4</sub> in Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> was applied. Measured magnetization  $M_{\text{measured}}$  in emu/g of the total sample was adjusted by dividing it by 0.75261 to obtain the specific magnetization of Fe<sub>3</sub>O<sub>4</sub>:  $M_{\text{Fe}_3\text{O}_4} = M_{\text{measured}}/0.75261$  as shown in Figure S1. The obtained values for saturation magnetization ( $M_s = 27.5$  emu/g Fe<sub>3</sub>O<sub>4</sub>) and coercive field ( $H_c = -0.078$  Oe) indicate that no significant amount of maghemite has formed in the Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> sample. Although the saturation magnetization is low compared to bulk Fe<sub>3</sub>O<sub>4</sub> (92-100 emu/g), this reduced value can be attributed to factors such as the nanometric size of the particles and the SiO<sub>2</sub> coating, which limit the effective magnetization. Additionally, the extremely low coercive field is characteristic of superparamagnetic materials or Fe<sub>3</sub>O<sub>4</sub> nanoparticles, opposing the presence of maghemite, which typically exhibits a higher coercivity. These results strongly suggest that the sample contains pure Fe<sub>3</sub>O<sub>4</sub> with no significant transformation to maghemite. For definitive confirmation, additional techniques such as Mössbauer Spectroscopy could be employed; however, the current data are consistent with the stability of Fe<sub>3</sub>O<sub>4</sub> in the sample with no evidence of oxidation to maghemite."



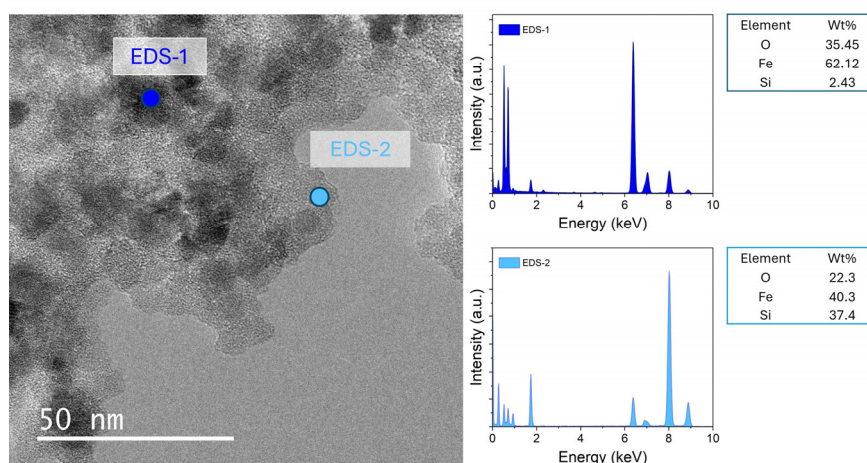
**Figure S1.** Magnetization curves at 300 K of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-NH<sub>2</sub> during the reheating process.



**Figure S2.** Representative SEM Images of the surface granularity of  $\text{Fe}_3\text{O}_4$  (a) and (b)  $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-NH}_2$  nanoparticles.



**Figure S3.** EDS of  $\text{Fe}_3\text{O}_4$  (a),  $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-NH}_2$  nanoparticles (b) and  $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-NH}_2/\text{P-88}$  nanoparticles (c).



**Figure S4.** TEM image and EDS spectra with elemental composition in two zones of the nanoparticles: EDS-1 in the core and EDS-2 on the  $\text{SiO}_2\text{-NH}_2$  coating.