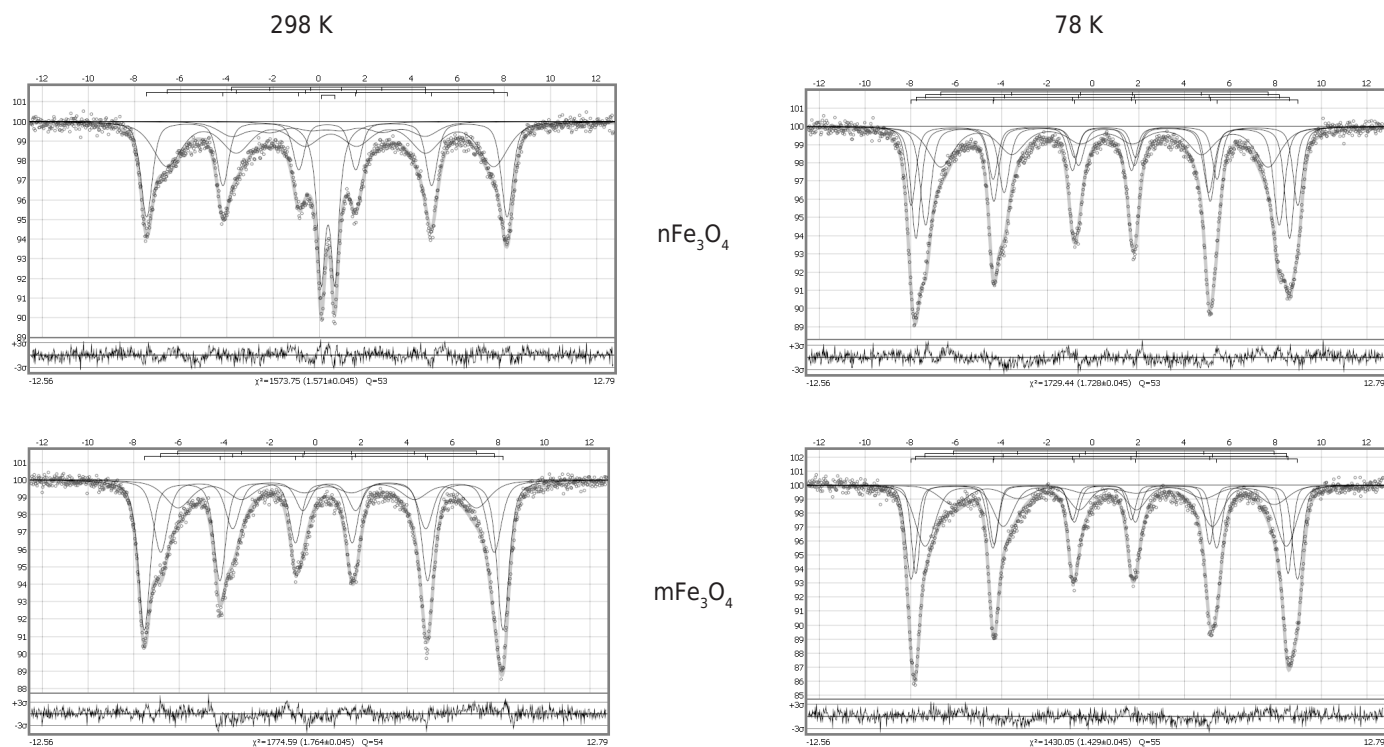


SUPPLEMENTARY MATERIAL

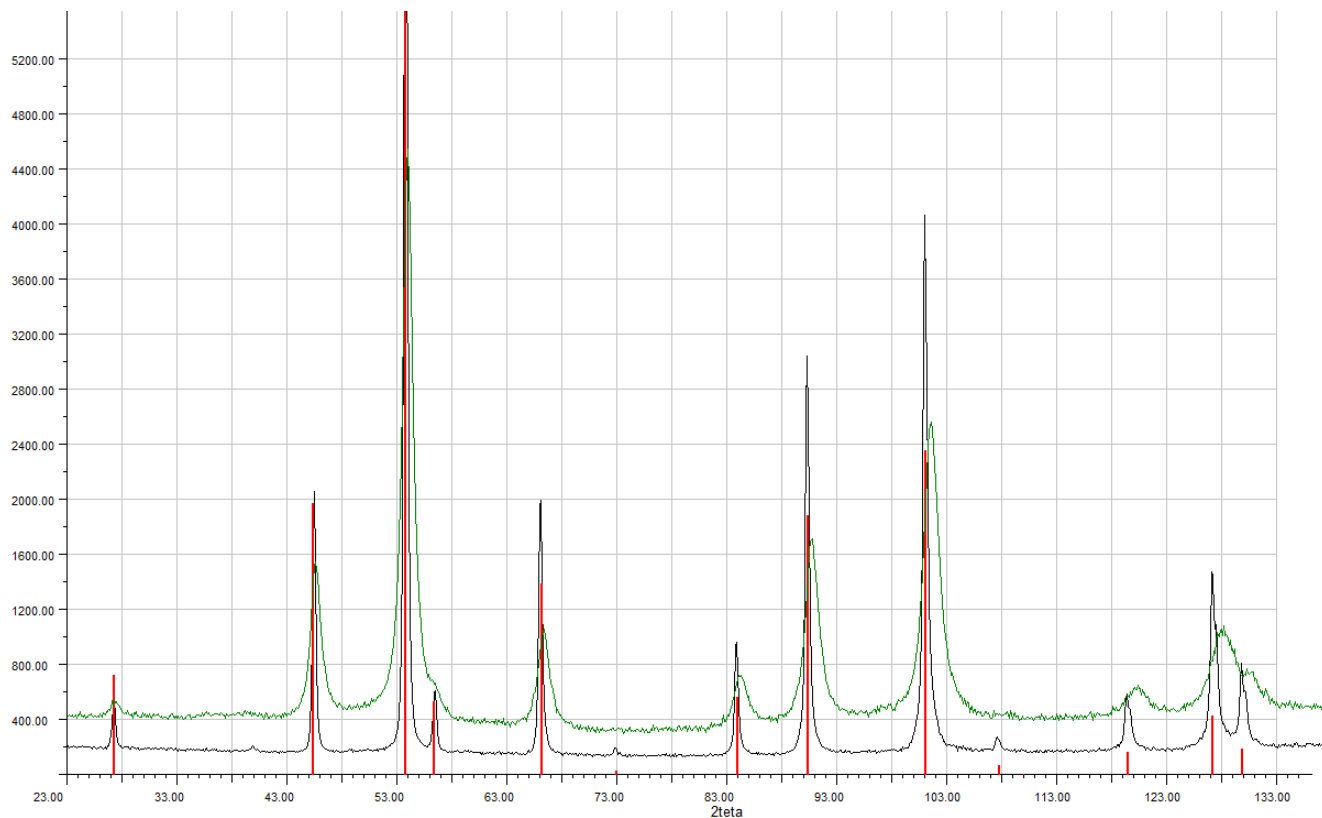


Supplementary Figure 1. Mössbauer spectra at 298 K and 78 K of magnetite nanoparticles ($n\text{Fe}_3\text{O}_4$) and magnetite microparticles ($m\text{Fe}_3\text{O}_4$)

Supplementary Table 1. Mössbauer spectra parameters of magnetite nanoparticles ($n\text{Fe}_3\text{O}_4$) and magnetite microparticles ($m\text{Fe}_3\text{O}_4$).

Sample (temperature, K)	#	δ , mm/s	ε (Δ), mm/s	Γ_{exp} , mm/s	H_{eff} , kOe	S, %
$m\text{Fe}_3\text{O}_4$ (298 K)	1	0.33 ± 0.01	-0.00 ± 0.01	0.62 ± 0.01	487.5 ± 0.1	50.1 ± 0.7
	2	0.53 ± 0.01	-0.04 ± 0.01	0.76 ± 0.02	453.1 ± 0.4	30 ± 2
	3	0.50 ± 0.01	-0.01 ± 0.01	1.38 ± 0.05	406 ± 2	20 ± 1
$m\text{Fe}_3\text{O}_4$ (78 K)	1	0.50 ± 0.01	-0.01 ± 0.01	0.55 ± 0.01	525.2 ± 0.4	28 ± 1
	2	0.38 ± 0.01	0.00 ± 0.01	0.46 ± 0.01	505.9 ± 0.3	22 ± 2
	3	0.59 ± 0.01	-0.05 ± 0.01	1.04 ± 0.03	491 ± 1	35 ± 2
	4	0.84 ± 0.02	0.06 ± 0.02	1.44 ± 0.07	436 ± 3	15 ± 1
$n\text{Fe}_3\text{O}_4$ (298 K)	1	0.33 ± 0.01	-0.01 ± 0.01	0.59 ± 0.01	483.7 ± 0.2	32 ± 1
	2	0.48 ± 0.01	-0.01 ± 0.01	1.46 ± 0.04	438 ± 1	37 ± 1
	3	0.34 ± 0.03	0.05 ± 0.03	1.38 ± 0.01	260 ± 2	11.1 ± 0.3
	4	0.37 ± 0.01	(0.29 ± 0.01)	0.43 ± 0.01		19.6 ± 0.3
$n\text{Fe}_3\text{O}_4$ (78 K)	1	0.51 ± 0.01	-0.01 ± 0.01	0.50 ± 0.01	525.5 ± 0.5	19 ± 1
	2	0.40 ± 0.01	0.02 ± 0.01	0.51 ± 0.01	507.7 ± 0.4	28 ± 2
	3	0.49 ± 0.01	-0.09 ± 0.01	0.57 ± 0.02	480.5 ± 0.4	28 ± 2
	4	0.54 ± 0.01	-0.05 ± 0.01	1.32 ± 0.03	445 ± 2	26 ± 1

δ - isomer shift, $\Delta = 2\varepsilon$ - quadrupole splitting, Γ_{exp} - line width, H_{eff} - hyperfine magnetic field, S - relative area of the subspectrum #.



Supplementary Figure 2. X-ray diffractograms of magnetite nanoparticles (green) and microparticles (black).

Sample	Initial	Processed
$n\text{Fe}_3\text{O}_4$		
$m\text{Fe}_3\text{O}_4$		

Supplementary Figure 3. Electron microscope images of magnetite nanoparticles ($n\text{Fe}_3\text{O}_4$) and magnetite microparticles ($m\text{Fe}_3\text{O}_4$).

Supplementary Table 2. Similarity between measured values (in mg kg⁻¹) and standard reference values.

	Cu	Zn	Pb	Cd	Fe	Mn
CRM 482 measured	7.2±0.5	89.1±2.7	36.9±0.0	0.535±0.0	774.4±22.9	26.2±3.6
CRM 482 reference	7.03±0.19	100.6±2.2	40±1.4	0.56±0.02	804±160	33.0±0.5
CRM 100 measured	11.0±0.6	64±2	15.5±0.4	0.355±0.07	541±28	1.29±0.06
CRM 100 reference	11.8±0.4	69±5	16.2±0.6	0.33±0.01	550±30	1.33±0.04