

Table 1S. Microstructure of MNPs

| Sample | Fe ₃ O ₄ (Ar) [Bondarenko et al., 2021] | | | Fe ₃ O ₄ (air) | | | Fe ₃ O ₄ /APTES (Ar) [Bondarenko et al., 2021] | | | Fe ₃ O ₄ /APTES (air) [Bondarenko et al., 2021] | | |
|----------------------------------|---|-------|----------|--------------------------------------|-----------|-----------|--|-------|----------|---|-------|----------|
| | hkl | 2Q, ° | d, Å | FWHM | 2Q, ° | d, Å | FWHM | 2Q, ° | d, Å | FWHM | 2Q, ° | d, Å |
| 220 | 45.45 | 2.965 | 0.636(8) | 45.65 | 8.352 (1) | 13.759(1) | 45.45 | 2.96 | 0.504(9) | 45.65 | 2,956 | 0.721(6) |
| 311 | 53.90 | 2.527 | 0.662(2) | 54.05 | 8.361(5) | 13.448(2) | 53.95 | 2.53 | 0.679(5) | 54.05 | 2,519 | 1.731(2) |
| 400 | 66.30 | 2.095 | 0.780(1) | 66.4 | 8.368(2) | 16.384(1) | 66.3 | 2.095 | 0.890(4) | 66.4 | 2,089 | 0.822(1) |
| 422 | 83.85 | 1.714 | 0.975(2) | 84.2 | 8.370(6) | 16.967(1) | 84.05 | 1.712 | 0.844(9) | 84.45 | 1,707 | 0.785(1) |
| 511 | 90.70 | 1.610 | 0.940(7) | 90.7 | 8.366(9) | 16.721(2) | 0.75 | 1.61 | 0.828(5) | 90.7 | 1,609 | 1.891(3) |
| 440 | 101.35 | 1.481 | 0.899(1) | 101.55 | 8.364(9) | 12.195(3) | 101.37 | 1.481 | 1.026(6) | 101.55 | 1,477 | 0.824(4) |
| a, Å | 8.3813 | | | 8.3641 | | | 8.3789 | | | 8.3603 | | |
| X | 0.37 | | | 0.22 | | | 0.35 | | | 0.187 | | |
| δ | 0.069 | | | 0.162 | | | 0.08 | | | 0.186 | | |
| Structure | Fe _{2,93} O ₄ | | | Fe _{2,84} O ₄ | | | Fe _{2,92} O ₄ | | | Fe _{2,81} O ₄ | | |
| % Fe ₃ O ₄ | 78.8 | | | 50.7 | | | 75.8 | | | 42.4 | | |
| D _{XRD} , nm | 17.1±2.3 | | | 14.9±2.02 | | | 20.5±3.3 | | | 16.5±1.96 | | |
| CV, % | 13.5 | | | 13.5 | | | 16.1 | | | 9.5 | | |

hkl – Miller indexes; d - interplanar distance, Å; Q - angle at which the reflex was measured; FWHM - full width at half maximum of XRD reflex; a - interplanar distance, Å; X - the Fe²⁺/Fe³⁺ ratio; δ – calculated value, which range from zero (stoichiometric magnetite) to 1/3 (completely oxidized); D_{XRD} - average particle size calculated by the Scherrer equation ± standard deviation, nm

Table 2S. Magnetic properties of bare and modified MNPs

| Sample | Saturation magnetization Ms, emu/g | Remanent magnetization Mr, emu/g | Coercive force Hc, Oe |
|---|------------------------------------|----------------------------------|-----------------------|
| Fe ₃ O ₄ (Ar) | 81.2 | 6.88 | 74.1 |
| Fe ₃ O ₄ (air) | 49.9 | 5.20 | 160 |
| Fe ₃ O ₄ -APTES (Ar) | 68.7 | 6.65 | 163 |
| Fe ₃ O ₄ -APTES (air) | 30.8 | 4.41 | 159 |

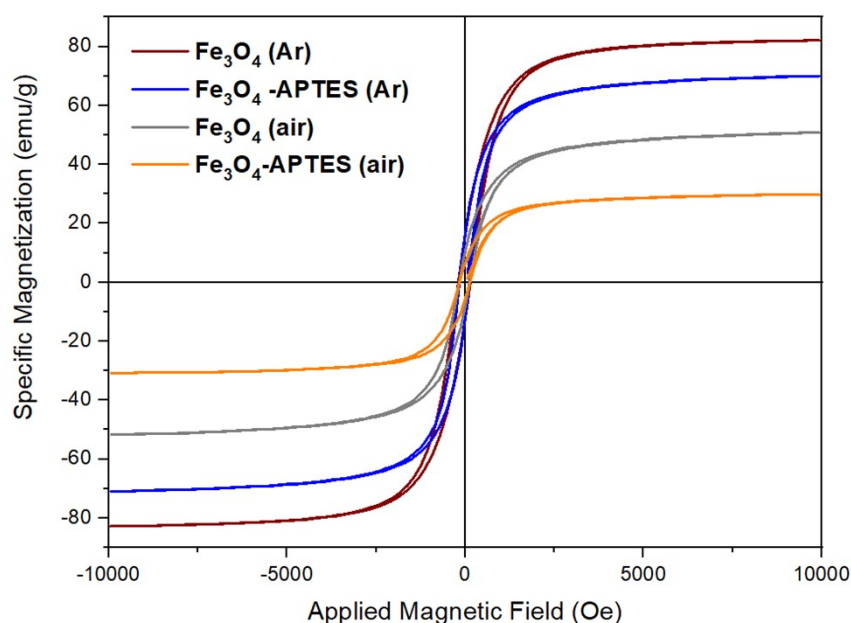


Figure 1S. Magnetic properties of MNPs

Table 3S. pH-dependence of samples

| Sample | Concentration, mg/L | pH | Zeta potential, mV ± SD | Hydrodynamic diameter, nm |
|--------------------------|---------------------|-----|-------------------------|---------------------------|
| Fe3O4 (Ar) | 10,0 | 5,4 | 20,1±4.5 | 473,0±63.3 |
| | 1,00 | 5,8 | -8,8±0.9 | 744,7±102.5 |
| | 0,500 | 6,7 | -14,6±1.7 | 470,9±73.8 |
| | 0,100 | 6,7 | -15,4±3.8 | 443,9±109.9 |
| | 0,0100 | 6,7 | -20,8±4.3 | 404,5±112.4 |
| Fe3O4 (air) | 10,0 | 4,0 | 10,2±1.9 | 756,4±85.7 |
| | 1,00 | 5,1 | -2,1±1.7 | 769,9±19.4 |
| | 0,500 | 7,5 | -13,2±3.6 | 852,8±27.6 |
| | 0,100 | 7,5 | -15,9±4.7 | 780,6±97.7 |
| | 0,0100 | 7,6 | -15,0±3.2 | 724,3±23.2 |
| Fe3O4/APTES (Ar) | 10,0 | 6,1 | 43,6±5.1 | 672,4±69.1 |
| | 1,00 | 6,1 | 15,0±2.5 | 957,1±140.2 |
| | 0,500 | 6,2 | -16,1±0.3 | 821,3± |
| | 0,100 | 6,5 | 23,6±3.5 | -- |
| | 0,0100 | 6,5 | -19,6±2.6 | 606,5±68.5 |
| Fe3O4/APTES (air) | 10,0 | 6,4 | 43,3±2.0 | 725,6±58.8 |
| | 1,00 | 7,0 | 43,5±3.5 | 728,5±62.7 |
| | 0,500 | 7,5 | 4,4±2.8 | 737,9±89.2 |
| | 0,100 | 7,4 | -15,6±3.5 | 720,5±82,2 |
| | 0,0100 | 7,5 | -21,2±4.2 | 748,4±27.4 |

Table 4S. ANOVA (Tukey's multiple comparisons test and p-value, before fractionation) of initial MNPs

| | mg/L |
|--------------|--------|
| Row 1 | 10.0 |
| Row 2 | 1.00 |
| Row 3 | 0.500 |
| Row 4 | 0.100 |
| Row 5 | 0.0100 |

| | p-value | |
|---|--------------------|----------------|
| | <i>P. caudatum</i> | <i>S. alba</i> |
| Fe₃O₄ (Ar) | | |
| Row 1 vs. Row 2 | 0.0915 | 0.9996 |
| Row 1 vs. Row 3 | 0.1309 | 0.3511 |
| Row 1 vs. Row 4 | 0.082 | 0.2872 |
| Row 1 vs. Row 5 | 0.3109 | 0.9431 |
| Row 2 vs. Row 3 | 0.993 | 0.4691 |
| Row 2 vs. Row 4 | 0.9579 | 0.3945 |
| Row 2 vs. Row 5 | 0.9463 | 0.9823 |
| Row 3 vs. Row 4 | 0.9305 | >0.9999 |
| Row 3 vs. Row 5 | 0.9999 | 0.794 |
| Row 4 vs. Row 5 | 0.9494 | 0.7223 |
| Fe₃O₄ (air) | | |
| Row 1 vs. Row 2 | 0.0496 | 0.9996 |
| Row 1 vs. Row 3 | 0.0404 | 0.9997 |
| Row 1 vs. Row 4 | 0.0391 | 0.9903 |
| Row 1 vs. Row 5 | 0.0079 | 0.5839 |
| Row 2 vs. Row 3 | 0.9987 | >0.9999 |
| Row 2 vs. Row 4 | 0.9926 | 0.9616 |
| Row 2 vs. Row 5 | >0.9999 | 0.7119 |
| Row 3 vs. Row 4 | 0.9964 | 0.9643 |
| Row 3 vs. Row 5 | >0.9999 | 0.704 |
| Row 4 vs. Row 5 | 0.9657 | 0.3171 |
| Fe₃O₄/APTES (Ar) | | |
| Row 1 vs. Row 2 | 0.0354 | 0.3149 |
| Row 1 vs. Row 3 | 0.0007 | 0.9818 |

| | | |
|--|--------|---------|
| Row 1 vs. Row 4 | 0.0022 | 0.8465 |
| Row 1 vs. Row 5 | 0.0004 | >0.9999 |
| Row 2 vs. Row 3 | 0.1086 | 0.1167 |
| Row 2 vs. Row 4 | 0.047 | 0.8846 |
| Row 2 vs. Row 5 | 0.1677 | 0.304 |
| Row 3 vs. Row 4 | 0.5082 | 0.5314 |
| Row 3 vs. Row 5 | 0.4321 | 0.9844 |
| Row 4 vs. Row 5 | 0.9545 | 0.8362 |
| Fe₃O₄/APTES (air) | | |
| Row 1 vs. Row 2 | 0.4857 | 0.5227 |
| Row 1 vs. Row 3 | 0.0427 | 0.9939 |
| Row 1 vs. Row 4 | 0.002 | 0.9923 |
| Row 1 vs. Row 5 | 0.0099 | 0.9641 |
| Row 2 vs. Row 3 | 0.1052 | 0.7693 |
| Row 2 vs. Row 4 | 0.0413 | 0.7841 |
| Row 2 vs. Row 5 | 0.1529 | 0.1919 |
| Row 3 vs. Row 4 | 0.496 | >0.9999 |
| Row 3 vs. Row 5 | 0.8348 | 0.8232 |
| Row 4 vs. Row 5 | 0.9998 | 0.8096 |
| | | |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ (air) | 0.7586 | 0.7104 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (Ar) | 0.9412 | 0.9842 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.2243 | 0.9425 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (Ar) | 0.9754 | 0.4922 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (air) | 0.0247 | 0.4377 |
| Fe ₃ O ₄ /APTES (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.0695 | 0.9949 |

Table 5S. ANOVA (Tukey's multiple comparisons test and p-value, after fractionation) of initial, centrifuged and filtered MNPs

| | p-value | |
|--|--------------------|----------------|
| | P. caudatum | S. alba |
| Fe₃O₄ (Ar) | | |
| ini vs. cent | <0.0001 | 0.0639 |
| ini vs. filtr | <0.0001 | 0.9249 |
| cent vs. filtr | 0.1969 | 0.1332 |
| Fe₃O₄ (air) | | |
| ini vs. cent | 0.9681 | 0.0002 |
| ini vs. filtr | 0.9681 | 0.9996 |
| cent vs. filtr | >0.9999 | 0.0002 |
| Fe₃O₄ /APTES (Ar) | | |
| ini vs. cent | <0.0001 | 0.9997 |
| ini vs. filtr | <0.0001 | 0.0889 |
| cent vs. filtr | 0.5136 | 0.0849 |
| Fe₃O₄ APTES (air) | | |
| ini vs. cent | <0.0001 | 0.0013 |
| ini vs. filtr | 0.0005 | <0.0001 |
| cent vs. filtr | 0.1588 | 0.4086 |
| initial | | |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ (air) | 0.0966 | 0.5715 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (Ar) | 0.0992 | 0.9963 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.3264 | 0.0004 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (Ar) | 0.9937 | 0.7025 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (air) | <0.0001 | <0.0001 |
| Fe ₃ O ₄ /APTES (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.0003 | 0.0003 |
| centrifugation | | |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ (air) | 0.0028 | <0.0001 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (Ar) | 0.9789 | 0.1557 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.4124 | 0.0251 |

| | | |
|--|--------|--------|
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (Ar) | 0.0017 | 0.0066 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (air) | 0.0018 | 0.0502 |
| Fe ₃ O ₄ /APTES (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.5484 | 0.8121 |
| filtration | | |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ (air) | 0.0006 | 0.8073 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (Ar) | 0.824 | 0.1967 |
| Fe ₃ O ₄ (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.2991 | 0.9955 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (Ar) | 0.0089 | 0.6575 |
| Fe ₃ O ₄ (air) vs. Fe ₃ O ₄ /APTES (air) | 0.0025 | 0.9094 |
| Fe ₃ O ₄ /APTES (Ar) vs. Fe ₃ O ₄ /APTES (air) | 0.9409 | 0.2872 |

* **ini** – initial, **cent** – centrifugation, **filtr** - filtration