**Supplementary material**

**Synthesis, characterization and application of magnetic nanoparticles modified with Fe-Mn binary oxide for the effective removal of As(III) and As(V) from water**

Jasmina Nikića, Malcolm A. Watson\*a, Marijana Kragulj Isakovskia, Aleksandra Tubića,

Marko Šolića, Branko Kordića, Jasmina Agbabaa

aUniversity of Novi Sad Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovića 3, 21000 Novi Sad, Republic of Serbia

\*Corresponding author: Malcolm Watson, email: malcolm.watson@dh.uns.ac.rs

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**Figure S1.** SEM images of a) MNp b) MNp-FeMn



**Figure S2.** XRD patterns of a) MNp b) MNp-FeMn



**Figure S3.** Effect of ionic strength on As(III) and As(V) removal by a) MNp b) MNp-FeMn

Initial As concentration 0.2 mg/l; sorbent dose 0.5 g/l



**Figure S4.** Effect of coexisting anions on As(III) and As(V) removal by a-b) MNp and c-d) MNp -FeMn

Initial As concentration 0.2 mg/l. adsorbent dose 0.5 g/l. initial solution pH 7.0 ± 0.2.

**Table S1**. EDS analysis of MNp and MNp-FeMn

|  |  |
| --- | --- |
| **Adsorbents** | **Element (%)** |
|  | C | O | Fe | Mn |
| MNp | 15.2 | 43.2 | 41.7 | - |
| MNp-FeMn | 8.75 | 47.4 | 35.0 | 8.84 |

 **Table S2.** Absorption bands of the FTIR spectra of MNp and MNp-FeMN before and after As(III) and As(V) adsorption

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Wavenumber (cm-1)** | **MNp** | **MNp-FeMn** | **MNp +As(III)** | **MNp****+As(V)** | **MNp-FeMn****+As(III)** | **MNp-FeMn +As(V)** | **Functional group** | **Reference** |
| 3420 | + | + | + | + | + | + | -OH stretching vibration of OH group(from H2O) | [20] |
| 1630 | + | + | + | + | + | + | -OH bending vibration of OH group(from H2O) |
| 1384 | - | - | + | - | - | - | -OH bending vibration of OH |  |
| 1050 | - | + | - | - | - | - | -OH bending vibration of OH group (Fe-OH) | [47,48] |
| 1120 | + | - | - | - | - | - |
| 825 | - | - | - | + | + | + | As–O stretching vibration(As–O–Fe) | [20,47,48] |
| 694 | + | - | + | + | - | - | Fe–O-Fe stretching vibration of the γ-Fe2O3 | [31] |
| 636 | + | + | + | + | + | + |
| 560 | + | + | + | + | + | + |