Supplementary Materials

Application of biobased substances in the synthesis of nanostructured magnetic core-shell materials

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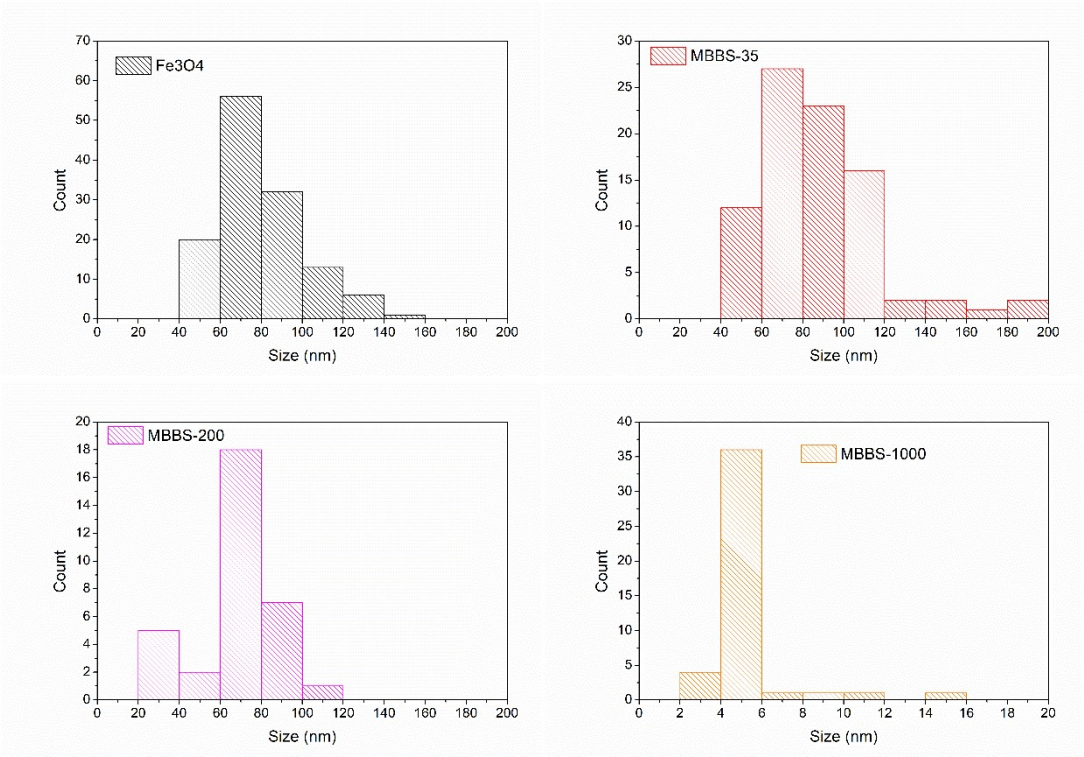

Figure S1. Particle size distribution obtained from TEM images.

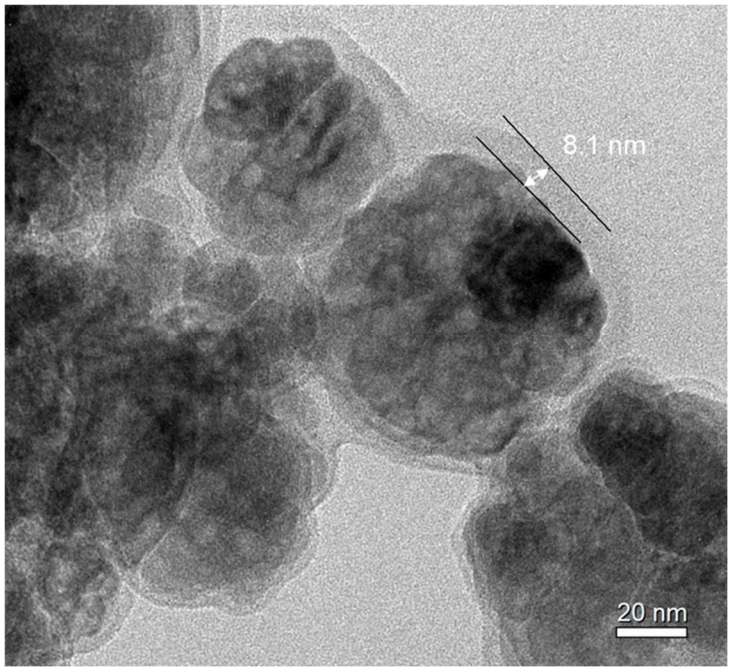

Figure S2. High resolution TEM image of MBBS-35

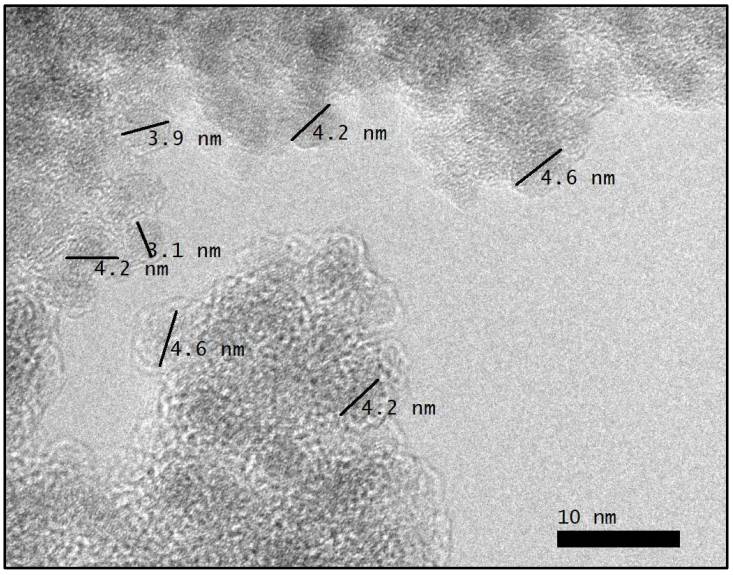

Figure S3. High resolution TEM image of MBBS-1000

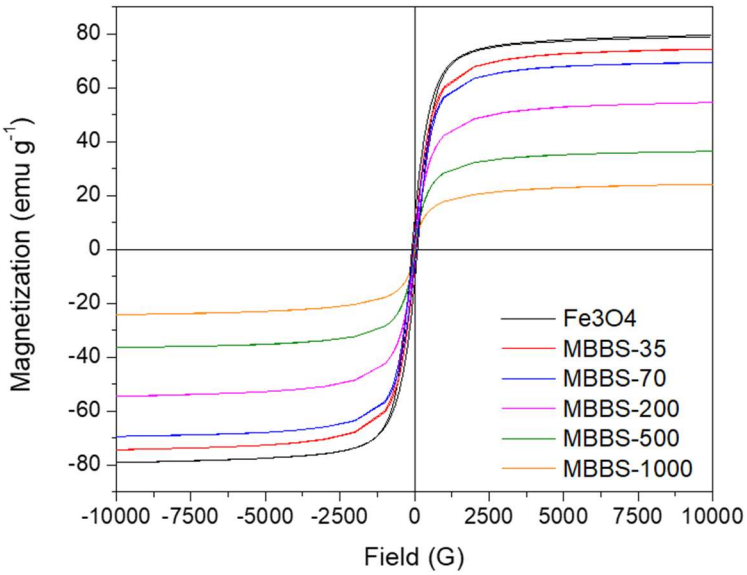

Figure S4. Magnetization curves (300 K) of Fe_3O_4 and covered magnetite with different amount of BBS.

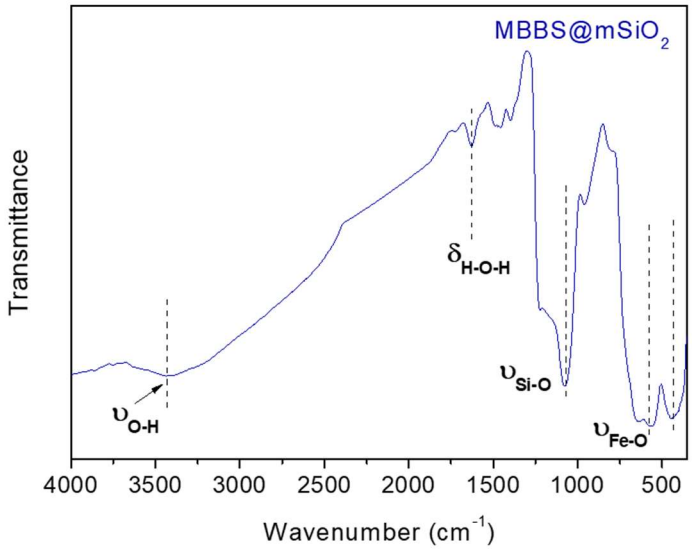

Figure S5. FTIR spectra of MBBS@$mSiO_2$ material

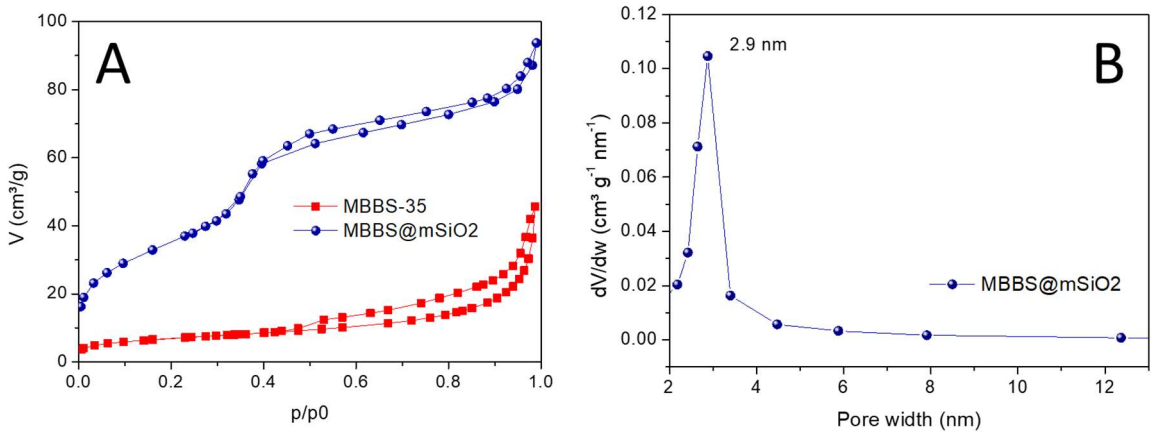

Figure S6. (A) N_2 adsorption/desorption isotherms of MBBS-35 and of MBBS@SiO_2 **(B)** pore-size distribution of MBBS@SiO_2

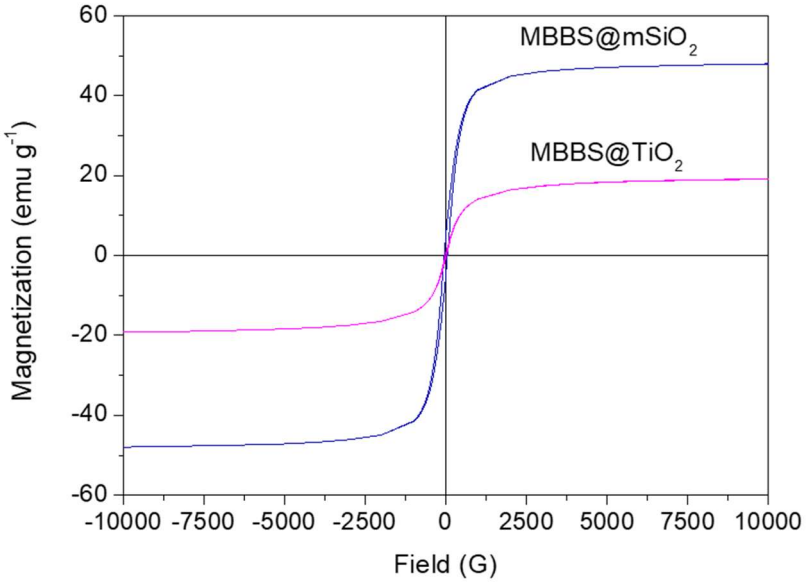

Figure S7. Magnetization curves at 300 K of MBBS@$mSiO_2$ and MBBS@TiO_2

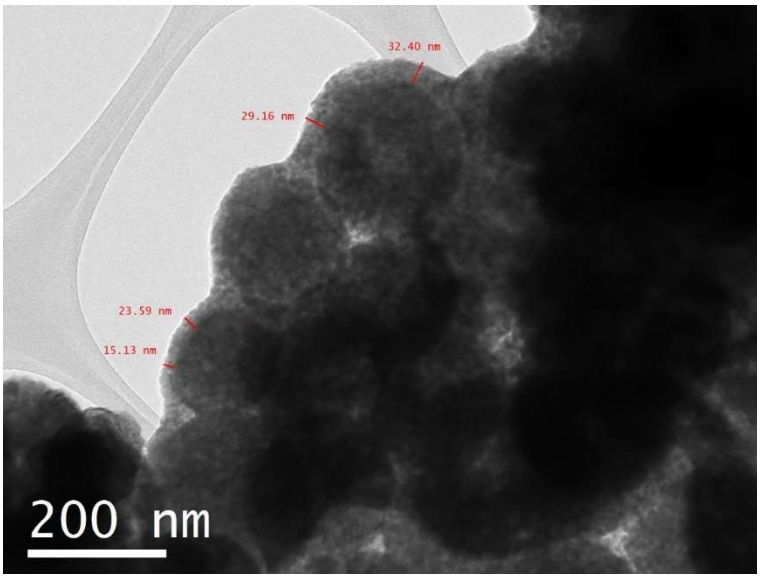

Figure S8. High resolution TEM image of MBBS@TiO_2. Red lines indicate the thickness of TiO_2 layer.

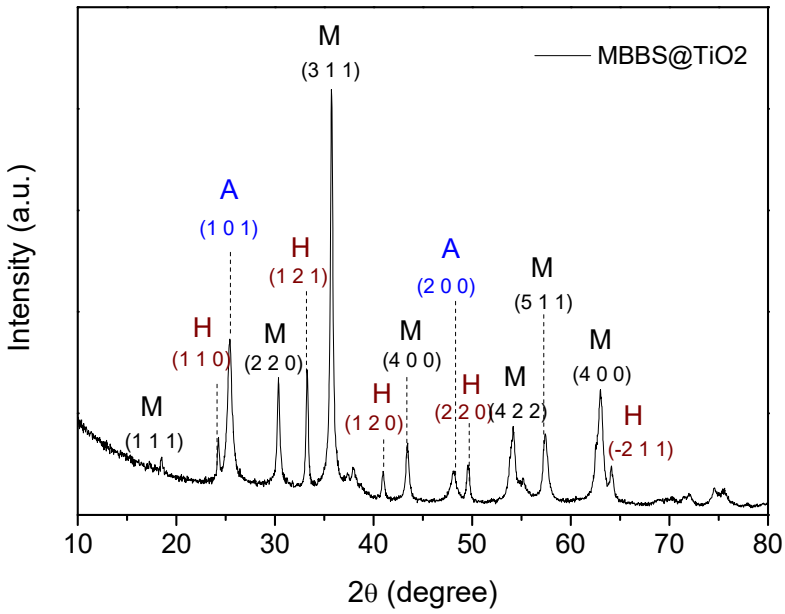

Figure S9. XRD diffraction pattern of MBBS@TiO_2. M (Magnetite), A (Anatase), and H (Hematite).

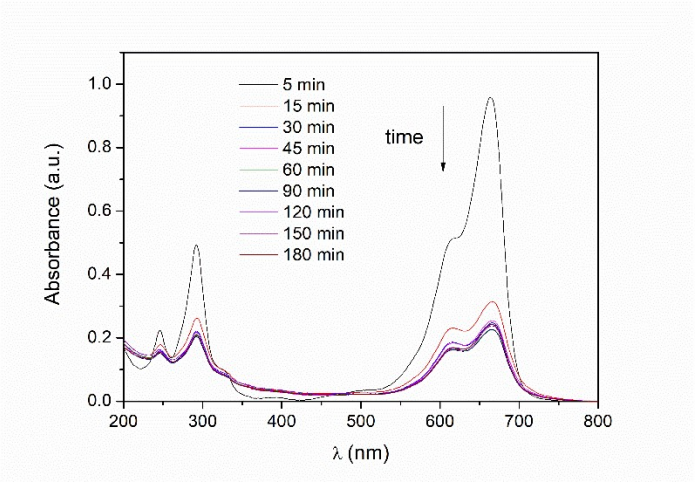

Figure S10. UV-Vis absorption spectra of aqueous solutions of MB at different contact times using MBBS@mSiO$_2$ as adsorbent. ([MB]$_0$ = 10 mg L^{-1}; MBBS@mSiO$_2$ dosage = 500 mg L^{-1}, T = 25 °C pH = 6.0).

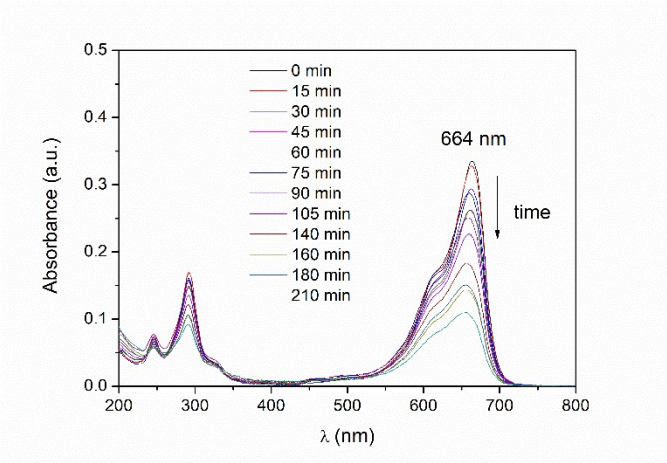

Figure S11. UV-Vis absorption spectra of aqueous solutions of MB at different irradiation times using MBBS@TiO$_2$ as photocatalyst. ([MB]$_0$ = 5 mg L^{-1}; load MBBS@TiO$_2$ = 120 mg L^{-1}; load TiO$_2$ = 40 mg L^{-1}; pH = 6.

Table S1. Total mass loss calculated by TGA for MBBS-X samples

Sample	Total mass loss (%)
Fe_3O_4	2.8
MBBS-35	5.2
MBBS-70	9.7
MBBS-200	23.7
MBBS-500	36.3
MBBS-1000	47.2

Table S2. Magnetic properties of BBS coated magnetic iron oxide nanoparticles

Sample	Magnetic saturation (emu g^{-1})	Coercivity (G)	Magnetic remanence (emu g^{-1})
Fe_3O_4	79.5	96.0	11.5
MBBS-35	75.4	57.0	6.3
MBBS-70	70.3	46.8	4.7
MBBS-200	56.1	19.8	2.0
MBBS-500	37.3	14.1	1.2
MBBS-1000	25.1	2.4	0.3
MBBS@$mSiO_2$	48.6	51.8	4.7
MBBS@TiO_2	19.7	20.0	0.6

Table S3. Zeta potential measurements of BBS coated magnetic iron oxide nanoparticles

Sample	pH 3	pH 6	pH 10
Fe_3O_4	41,8	10,1	-7,5
MBBS-35	24,3	-23,5	-27
MBBS-70	4,9	-31,2	-41,7
MBBS-200	-0,3	-33,1	-44,5
MBBS-500	-5,3	-35,9	-45,7
MBBS-1000	-7,9	-25,7	-49,3

Table S4: Chemical composition of BBS [(a)].

Metal analysis						
Si (%)	Fe (%)	Al (%)	Mg (%)	Ca (%)	K (%)	Na (%)
12.14 ± 0.07	1.03 ± 0.02	0.59 ± 0.01	1.67 ± 0.25	4.86 ± 0.61	1.18 ± 0.07	0.06 ± 0.01
Microelements						
Cu (ppm)	Ni (ppm)	Zn (ppm)	Cr (ppm)	Pb (ppm)	Cd (ppm)	Hg (ppm)
73 ± 1	100 ± 3	157 ± 13	49 ± 1	43 ± 2	< 0.02	< 0.02
General characteristics				Characteristics in aqueous solution (3 g L^{-1})		
Moisture (%)	Ashes (%)	C (%)	N (%)	pH	Conductivity (µS/cm)	Surface tension (N/m)
3.69	31.2	39.94 ± 0.35	4.82 ± 0.14	9.02	429	56.8
Concentration values as mole fraction of total C for functional groups and C types in by NMR analysis[(b)]						
Aliph	NR	COOH	OR	Ph	PhOH	Kt
0.31	0.07	0.12	0.20	0.16	0.06	0.02

[(a)] From Nisticò, R. et al. From biowaste to magnet-responsive materials for water remediation from polycyclic aromatic hydrocarbons, Chemosphere. 202 (2018) 686–693.

[(b)] Legends: aliph = aliphatic groups, NR = amino groups, COOH = carboxylic acids, OR = alcoxy groups, Ph = aromatic phenyl groups, PhOH = phenoxy groups, Kt = ketones.