Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supplementary Information for

Effect of Different Molecular Coating on the Heating Properties of Maghemite Nanoparticles

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LITERATURE COMPARISON

Table 1S. Parameters for spinel iron oxide samples reported in the literature. Saturation magnetization (M_s), zeta potential (ζ), applied frequency (f) and amplitude (A), specific power adsorption (SPA), intrinsic loss power (ILP).

Particle size (nm)	Aggregate size (nm)	Morphology	Coating	Solvent	Ms (emu/g)	ζ (mV)	f (kHz)	A (kA/m)	SAR (W/g)	ILP	Ref
11.5#		Spheroidal	Agar	Water	~60	-23.2	276	9.8	116	4.38	1
8#	~30£	Spheroidal	APTES	Water		10.1	522	7.5	8	0.27	2
13#	~60£	Spheroidal	APTES	Water		9.2	522	7.5	56	1.91	
10§		Spheroidal	Chitosan	Water	75	+48	190	7.9	6.5	0.55	3
11#	49£	Spheroidal	Citric Acid	Water	74	~-50	186	46	~200	~0.5	4
13#	65£	Spheroidal	Citric Acid	Water	83	~-50	186	46	~250	~0.6	
37#		Cubic	Citric Acid	Water	82		260	57	304	0.36	5
40#		Cubic	Citric Acid	Toluene	84		260	57	324	0.38	
9#		Spheroidal	Citric Acid	Water	28		128	20.3	10.7	0.20	6
12#	~20£	Spheroidal	Citric Acid-Chitosan	Water	75.5		215	27	184	1.17	7
3#		Spheroidal	Dextran 10 kDa	Water	8.3		120	28	0	0	8
4.5#		Spheroidal	Dextran 10 kDa	Water	26.5		120	28	0	0	
7#		Spheroidal	Dextran 10 kDa	Water	33.8		120	28	~3	~0.03	
8#		Spheroidal	Dextran 10 kDa	Water	44.4		120	28	~15	~0.16	
11.5#	74£	Spheroidal	Dextran 10 kDa	Water	59.2		120	28	~30	~0.32	
15#		Spheroidal	Dextran 10 kDa	Water	64.0		120	28	~50	~0.53	
19#		Spheroidal	Dextran 10 kDa	Water	67.9		120	28	55	0.58	
15#	148£	Spheroidal	Dextran 10 kDa	Water	59		178	6.3	113	16	9
10§		Spherical	Dextran 150 kDa	Water			357	20	71	0.50	10
10§		Spherical	Dextran 70 kDa	Water			357	20	35	0.25	
10§		Spherical	Dextran 40 kDa	Water			357	20	25	0.18	
10#	16£	Spherical	DMSA	Water	69		741	~5.1	~10	~0.52	11
14#	21£	Spherical	DMSA	Water	82		741	~5.1	~10	~0.52	
18#	34£	Spherical	DMSA	Water	96		741	~5.1	~100	~5.19	
10#	16£	Spherical	DMSA	Water	69		741	~5.1	~10	~0.52	
14#	28£	Spherical	DMSA	Water			838	20.05	20	0.06	12
14#	46£	Spherical	DMSA	Water			838	20.05	20	0.06	
11.4#		Spheroidal	DMSA	Water			273	10.3	9.4	0.32	13
10#	80£	Spheroidal	DMSA	Water	77		145	35.6	22.6	0.12	14
11#	65£	Spheroidal	DMSA	Water	79		145	35.6	21	0.11	
18#	80£	Spheroidal	DMSA	Water	76		145	35.6	67.7	0.37	
14#		Spheroidal	Dopamine	Water	70		530	20	109	0.51	15
11#		Spheroidal	Gelatine	Water	~60	-25.9	276	9.8	150	5.66	1
12-15@	~250£	Spheroidal	HDTMS	Lipiodol	36		1048	5.8	11.5	0.33	16
12-15@	~200£	Spheroidal	HDTMS	Lipiodol	50		1048	5.8	16.9	0.48	
12-15@	~200£	Spheroidal	HDTMS	Lipiodol	56		1048	5.8	15.3	0.43	
12-15@	~150£	Spheroidal	HDTMS	Lipiodol	61		1048	5.8	18.0	0.51	
23.4#	81£	Spheroidal	Hyaluronic acid	Water	29.6	-21	120	12	62	3.59	17
9#	75£	Spheroidal	MAN	Water		-30	190	10	16	0.84	18
8#		Spherical	NDOPA-PEG	Water	45	-40	300	5	9	1.20	19
15.5#		Cubic	Oleic Acid	Toluene	107		380	16	356*	3.66	20
19#		Spherical	Oleic Acid	Toluene	102		380	16	190*	1.95	
10#	50£	Spheroidal	Oleic Acid	Hexane			145	35.6	70.9	0.39	14
18#	60£	Spheroidal	Oleic Acid	Hexane			145	35.6	383.9	2.09	
5#	78£	Spherical	PAA	Water	54	-37	450	15.95	30	0.27	21
10#	84£	Spherical	PAA	Water	64	-36	450	15.95	34	0.30	
12#	81£	Spherical	PAA	Water	69	-35	450	15.95	48	0.42	
15#	79£	Spherical	PAA	Water	71	-42	450	15.95	65	0.57	
20#	92£	Spherical	PAA	Water	75	-41	540	15.95	123	1.08	
7.9@	640#	Spherical aggregates	PAA	Water	50.4		126	31.6	80.5	0.64	22
6.0@	455#	Spherical aggregates	PAA	Water	52.8		126	31.6	41.1	0.33	
10#		Spheroidal	PAA	Water	62		340	~9.6	~40	1.28	23
15#		Spheroidal	PAA	Water	67		340	~9.6	~60	1.91	
20#		Spheroidal	PAA	Water	69		340	~9.6	~100	3.19	
13#	13#	Spherical aggregates	PAA	Water	58		765	25	~120*	~0.25*	24

Particle size (nm)	Aggregate size (nm)	Morphology	Coating	Solvent	Ms (emu/g)	ζ (mV)	f (kHz)	A (kA/m)	SAR (W/g)	ILP	Ref
13#	50#	Spherical aggregates	PAA	Water	71		765	25	~420*	~0.88*	24
13#	86#	Spherical aggregates	PAA	Water	74		765	25	~190*	~0.40*	24
13#	98#	Spherical aggregates	PAA	Water	76		765	25	~180*	~0.38*	24
10#	~110£	Spheroidal	PAM-PEI	Water		~-40	621.7	7.30	~15	0.45	25
9#	173£	Spheroidal	PDM	Water		-30	190	10	12	0.63	18
11#		Spheroidal	Pectin	Water	13		276	20.05	~30	~0.27	26
15#	50-60	Spheroidal	PEG	Water			345	36.5	~300	~0.6	27
30#	150£	Platelet	PEG-b-PVBP	Water	81		114	50.9	300	1.02	28
12#	109£	Spheroidal	PEG-FO	PBS	73		280	15	11.7	0.24	29
20£	20£	-	PEO	Water	~50		22.4	15.95	1.41	0.25	30
~9#	12.6£	Polyhedral	PMA	Water		-59	512	19.94	~58	~0.28	31
13#	80£	Spherical	PMAO	Water	65	-41	178	6.4	66	9.05	32
13#	32£	Cubic	PMAO	Water		~-40	183	17	110	2.08	33
15#	34£	Cubic	PMAO	Water	83	~-35	183	17	175	3.31	
19#	41£	Cubic	PMAO	Water		~-27	183	17	192	3.63	
22#	101£	Spherical	PMAO	Water			838	20.05	221	0.66	12
22#	137£	Spherical	PMAO	Water			838	20.05	175	0.52	
10#		Spheroidal	Polyphenol	Water	44		337	7.74	105	5.20	
13#		Spherical	POPC	Water	30		310	47.86	150	0.21	
10#	103£	Spheroidal	P(PEGMA-AA)	Water	55	-35	323	15.9	50.3	0.62	
20#	38£	Cubic	PScMA	Water	~100		302	23.8	213	1.25	
20#	51£	Cubic dimers and trimers	PScMA	Water	~110		302	23.8	253	1.48	
20#	99£	Cubic aggregates	PScMA	Water	~90		302	23.8	184	1.08	34
6@	70#	Spherical aggregates	PVP	Water	64	23	50	36	164	2.53	
70#	110£	Octahedron	PVP	Water	82	-29	316	47.86	963	1.33	35
70#	110£	Octahedron	PVP	EG	82	-29	316	47.86	604	0.83	
70#	110£	Octahedron	PVP	Agar	82	-29	316	47.86	457	0.63	
11#		Spheroidal	SDS	Water	~70	-12.7	276	9.8	98	3.7	1
30#	27.5£	Spherical	Tannic Acid	Water	108		300	20	~700	~6	36
8@	10£	Spheroidal	TMAOH	Water	42		126	63	136	0.27	37
18.5#		Spherical	TREG	Water	59		120	19	18.5	0.43	38
13.5#		Spheroidal	Uncoated	Water	28.5		400	31.91	97.5	0.24	39
16.7#		Spheroidal	Uncoated	Water	42		400	31.91	181	0.44	
18.1#		Spheroidal	Uncoated	Water	54.2		400	31.91	~126	0.31	
6#	49£	Spheroidal	Uncoated	Water		8.3	522	7.5	4	0.14	2
8#	55£	Spheroidal	Uncoated	Water		7.6	522	7.5	10	0.34	
11#	62£	Spheroidal	Uncoated	Water		7.9	522	7.5	42	1.43	
13#	75£	Spheroidal	Uncoated	Water		6.5	522	7.5	55	1.87	
14#	65£	Spheroidal	Uncoated	Water		8.0	522	7.5	58	1.98	
8#		Spheroidal	Uncoated	Agar 1%		7.6	522	7.5	10	0.34	
11#		Spheroidal	Uncoated	Agar 1%		7.9	522	7.5	40	1.36	
13#		Spheroidal	Uncoated	Agar 1%		6.5	522	7.5	41	1.40	
14#		Spheroidal	Uncoated	Agar 1%		8.0	522	7.5	40	1.36	

Size determined from: §: Magnetic measurements, #: TEM, @: XRD, £: DLS.

***SAR determined as:** W/g_{Fe}.

APTES = (3-AminoPropyl)TriEthoxySilane; DMSA = 2,3-DiMercaptoSuccinnic Acid; HDTMS = HexaDecylTriMethoxySilane; MAN = D-MANnose; NDOPA-PEG = NitroDOPAmine - PolyEthylene Glycol; PAA = PolyAcrylic Acid; PAM- PDM = Poly(N,N-DiMethylacrylamide-co-acrylic acid); PBS = Phosphate Buffer Saline; PEG-b-PVBP = PolyEthylene Glycol - Poly(4-VinylBenzylPhosphonate) block copolymer; PEG-FO = PolyEthylene Glycol-Folic Acid; PEI = Poly(Acrylic acid-co-Maleic acid) – PolyEthylenImine; PEO = PolyEthylene Oxide; PMA = Poly (isobutylene-alt-Maleic Anhydride)-graft-dodecyl; PMAO = Poly Maleic Anhydride-alt-1-Octadecene; POPC = 1-Palmitoyl-2-Oleoyl-sn-glycero-3-Phosphoti-dylCholine; P(PEGMA-AA) = coPolymer Poly(Ethylene Glycol) methyl ether MethAcrylate - Acrylic Acid; PScMA = Poly(Styrene-co-Maleic Anhydride); PVP = PolyVinylPyrrolidone; SDS = Sodium DodecylSulfate; TMAOH = TetraMethyl Ammonium HydrOxide; TREG = TRi Ethylene Glycol.

TGA ANALYSES

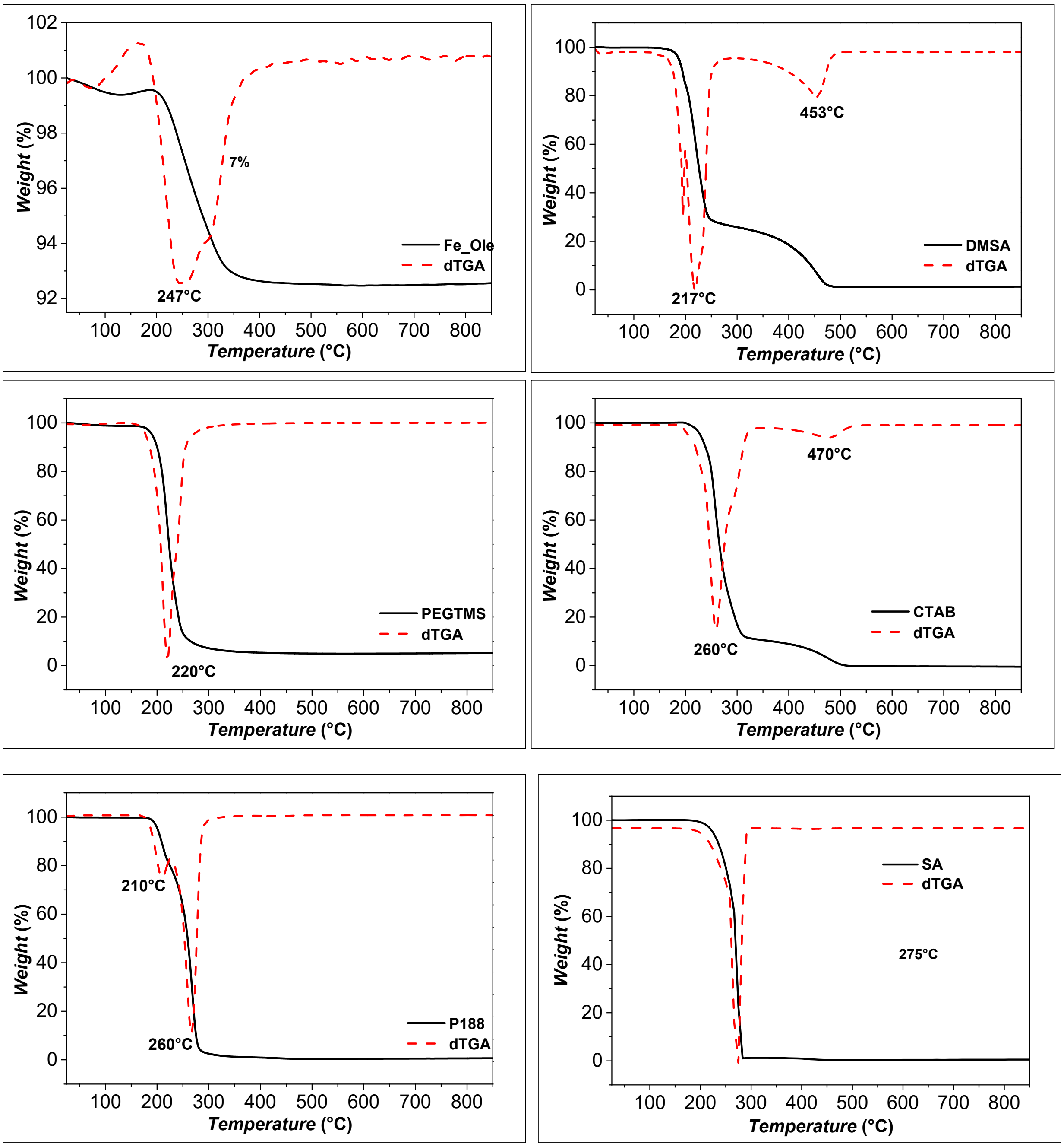

Figure 1S. TGA curves of Fe_Ole and the molecules used for surface functionalization. The dotted line represents the 1st derivative.

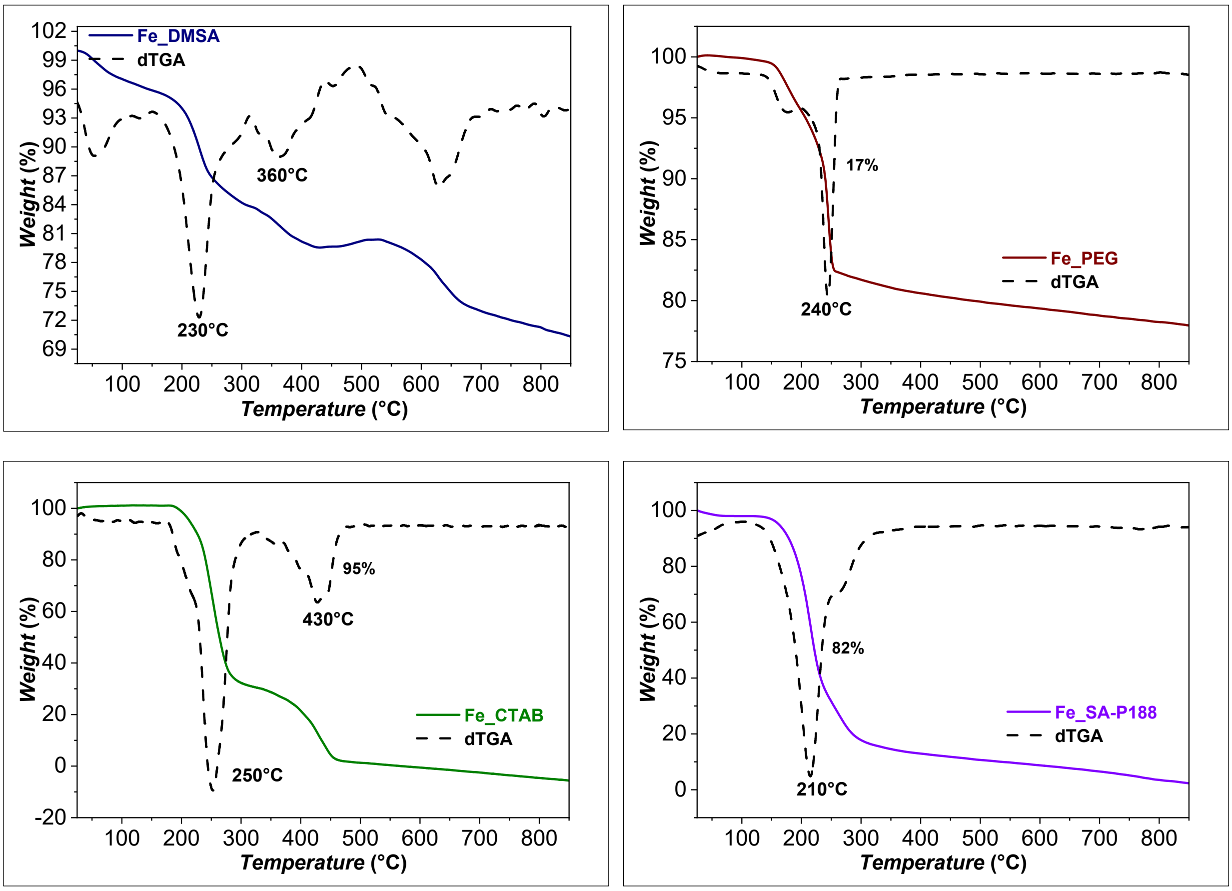

Figure 2S. TGA curves of the samples after surface functionalization. The dotted line represents the 1st derivative.

MAGNETIC MEASUREMENTS

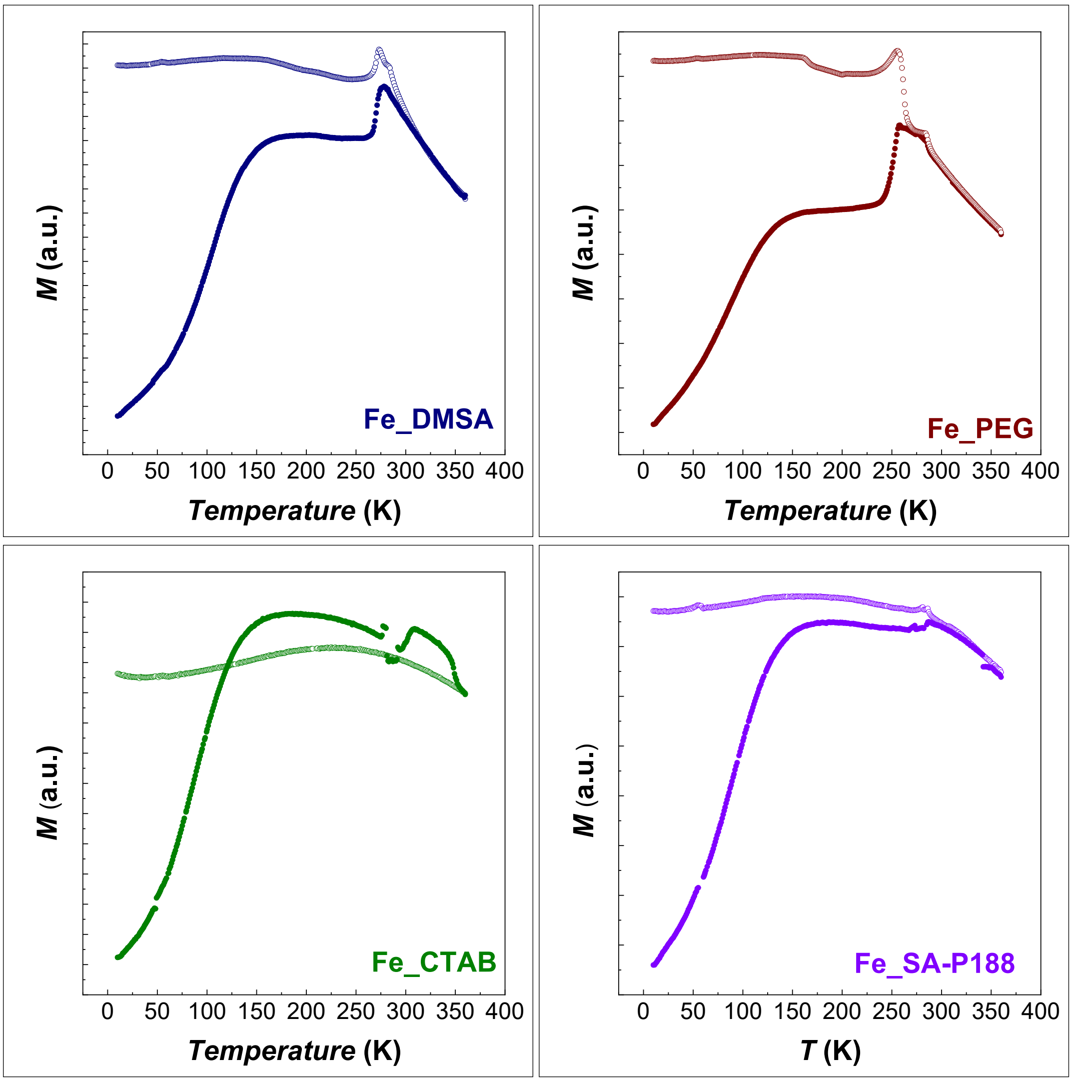

Figure 3S. ZFC-FC measurements of the dispersions at 100 Oe.

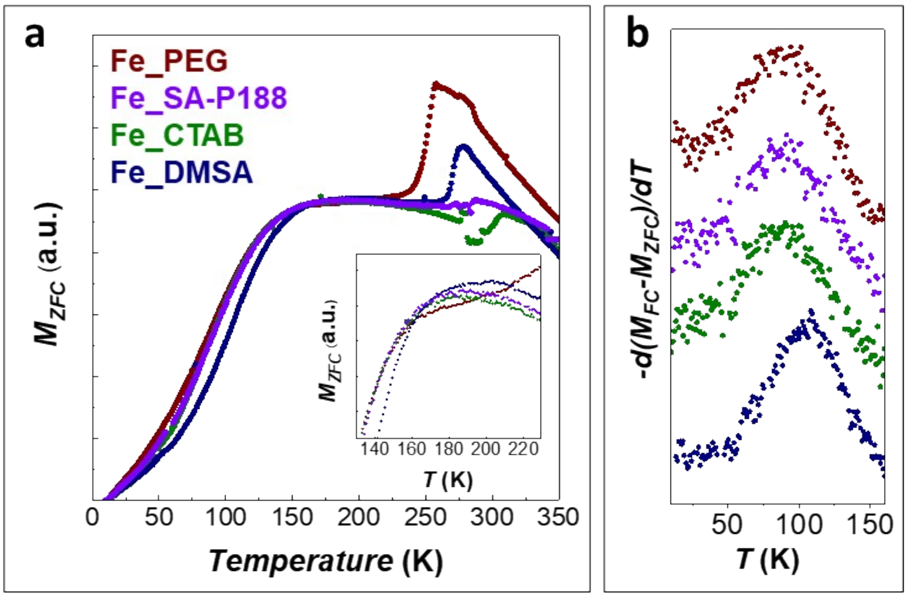

Figure 4S. ZFC Curves of the dispersions at 100 Oe (a) and relative distribution of blocking temperatures (b).

MFH MEASUREMENTS

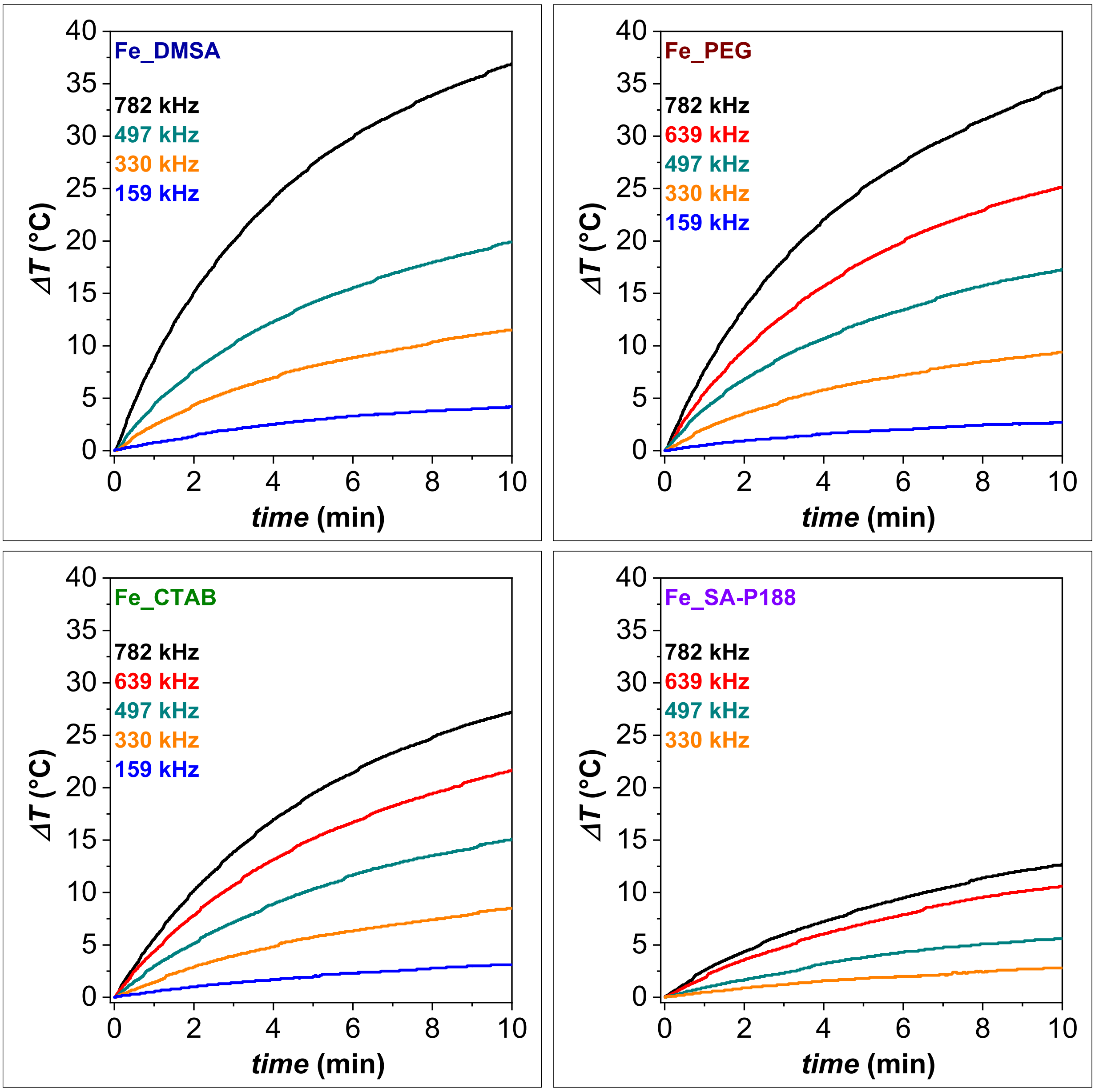

Figure 5S. Heat dissipation of the samples measured at 316 G and at various frequencies.

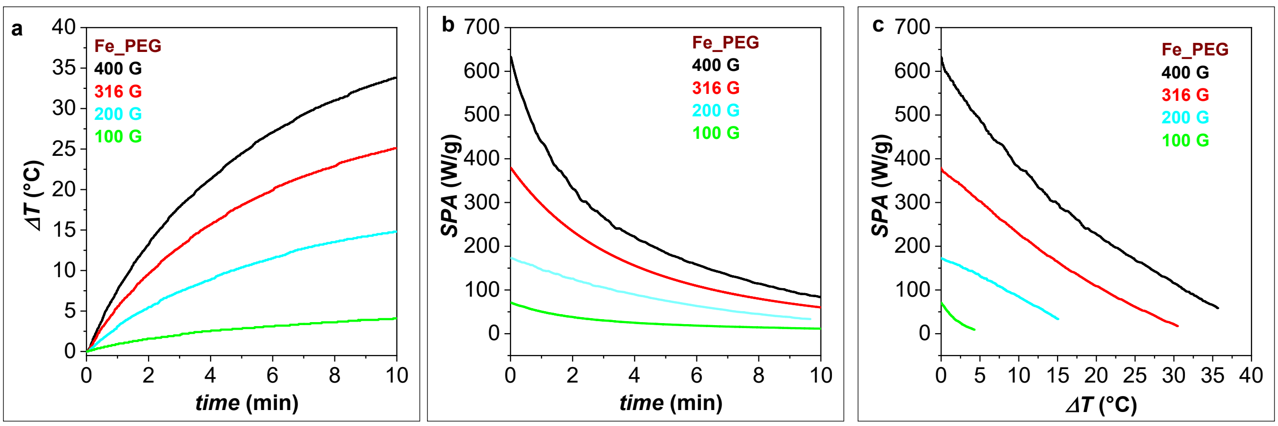

Figure 6S. Heat dissipation (a) and corresponding SPA curves *vs* time (b) and temperature (c) of the sample Fe_PEG measured at 639 kHz and various applied field amplitude.

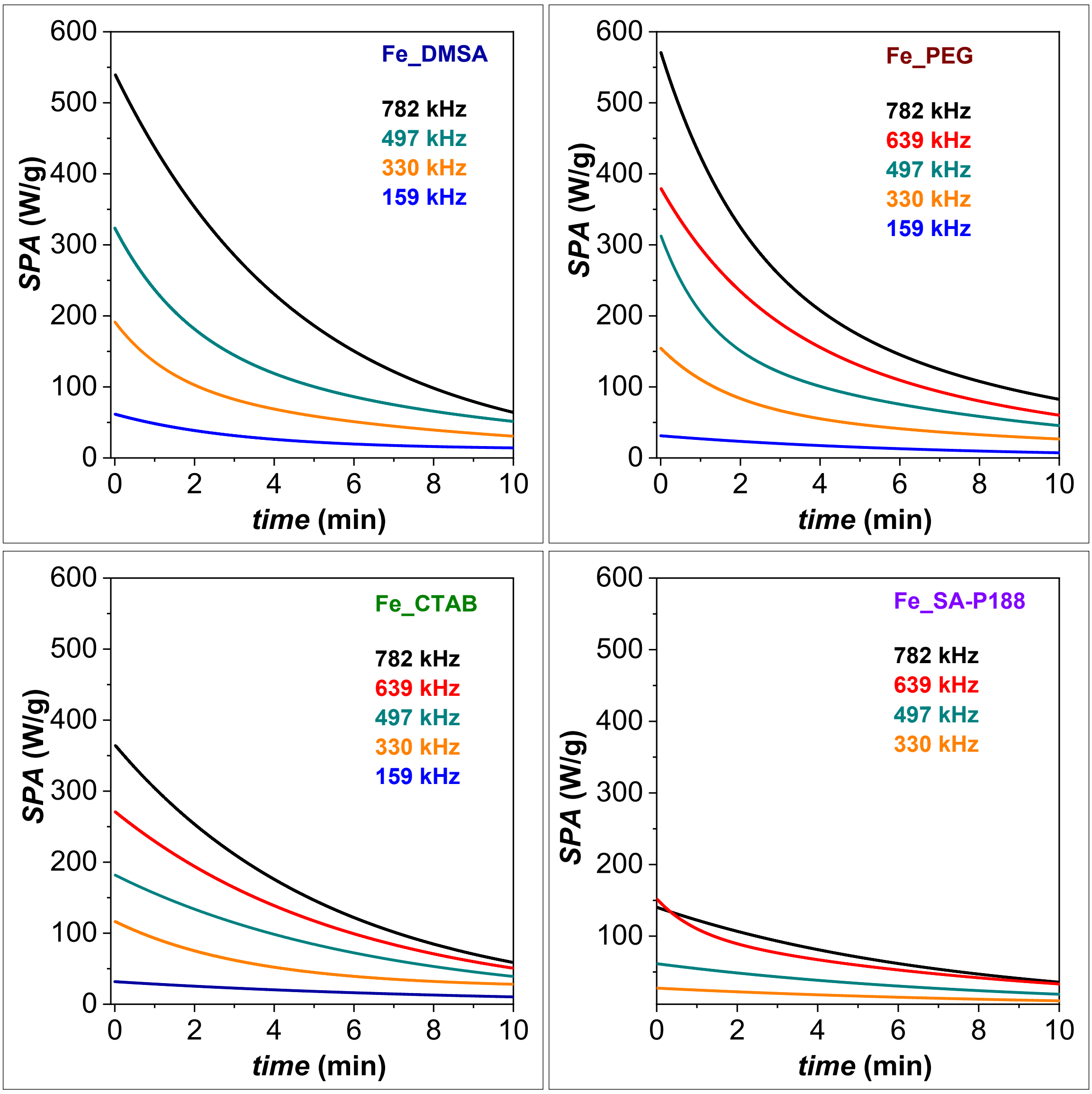

Figure 7S. SPA *vs* Time graphs of the samples measured at 316 G and at various frequencies.

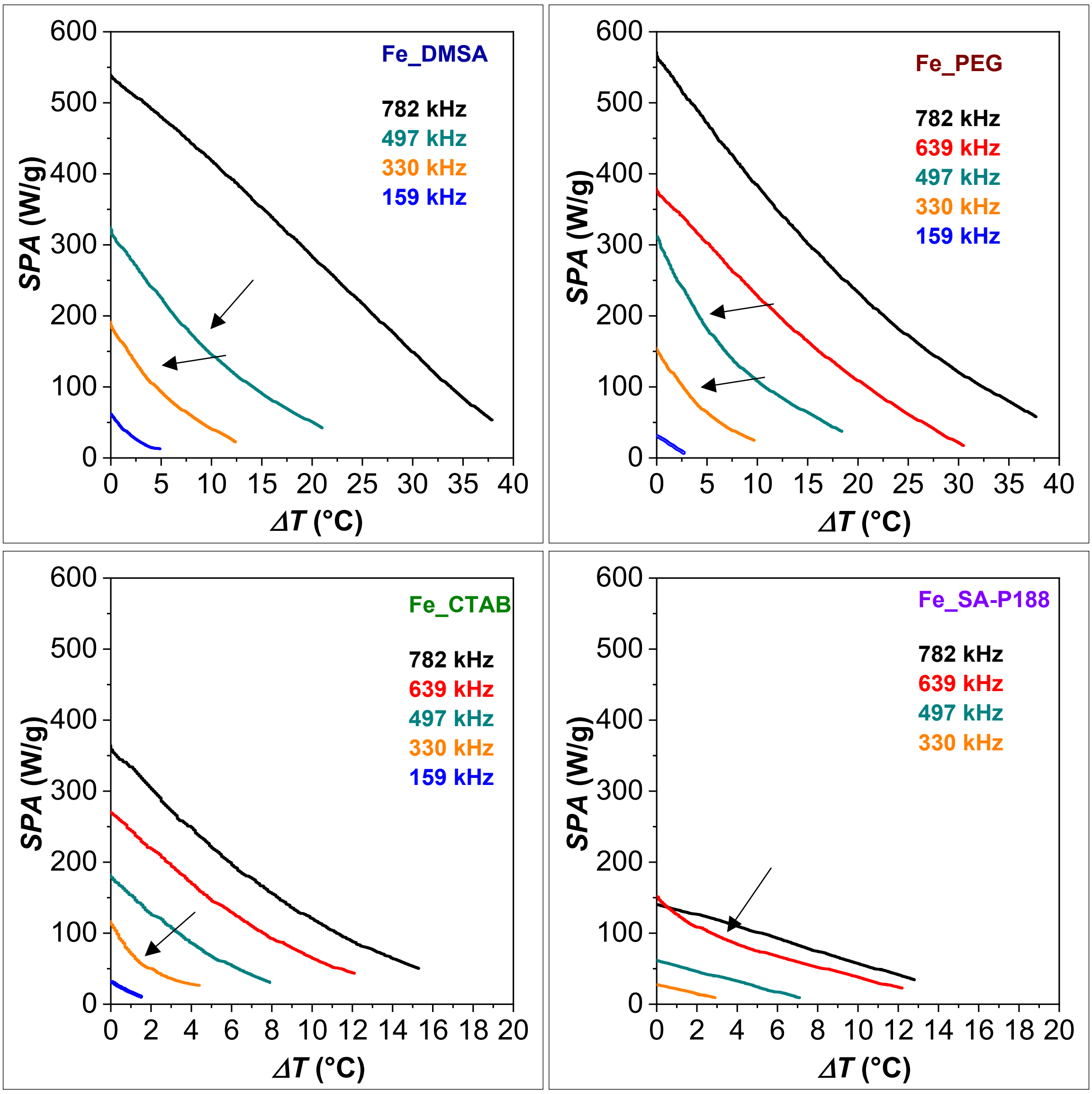

Figure 8S. SPA *vs* Temperature graphs of the samples measured at 316 G and at various frequencies.

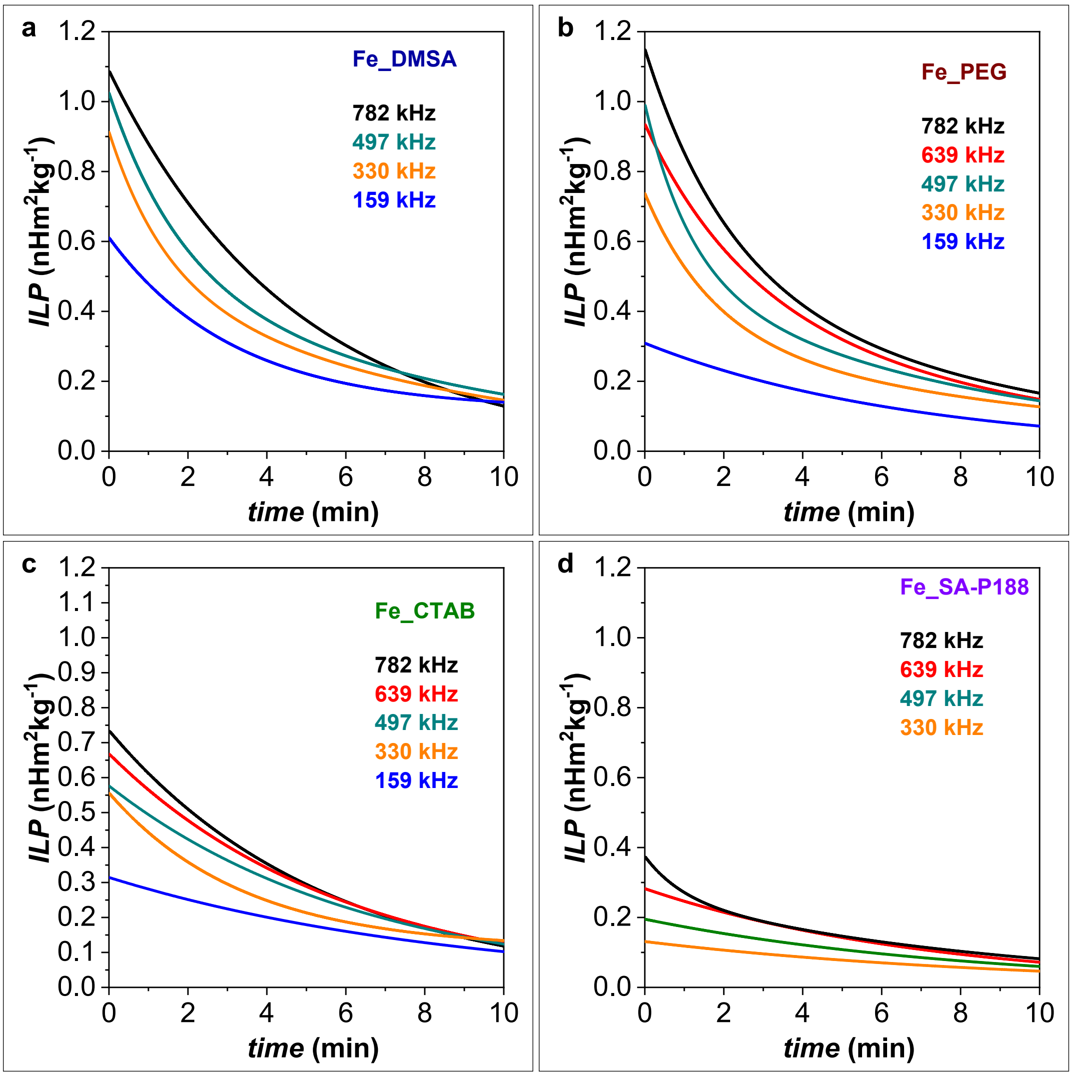

Figure 9S. ILP *vs* Time graphs of the samples measured at 316 G and at various frequencies.

Table 2S. Experimental conditions of the heat release test of water colloidal dispersions (1.12 mg/mL) of modified samples. Temperature increases after 10 minutes of alternate magnetic field (ΔT) and final temperature reached (T_{fin}).

Experimental conditions	159 kHz, 316 G		330 kHz, 316 G		497 kHz, 316 G		639 kHz, 100 G		639 kHz, 200 G		639 kHz, 316 G		639 kHz, 400 G		782 kHz, 316 G	
Sample	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)	ΔT (°C)	T_{fin} (°C)
Fe_DMSA	4.2	23.6	11.5	31.2	19.9	50.9	-	-	-	-	-	-	-	-	36.9	58.2
Fe_PEG	2.7	25.1	9.4	31.7	17.3	38.8	4.1	25.8	14.8	34.9	25.1	47.2	33.8	53.3	34.7	55.2
Fe_CTAB	3.1	25.1	8.5	30.6	15.1	36.8	-	-	-	-	21.7	43.6	-	-	27.2	50.7
Fe_SA-P188	-	-	2.8	24.5	5.6	26.8	-	-	-	-	10.6	29.4	-	-	12.7	34.8

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