

Supplementary material

Dispersions of metal oxides in the presence of anionic surfactants

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The time of aging of dispersions is given in Table S1.

Table S1. The time of aging of dispersions

molarity	Time aged (days)
Hematite C14	
1e-7	4
3e-7	5
5e-7	4
1e-6	5
2e-6	1
1e-5	4

Hematite C16	
3e-8	3
5e-8	3
1e-6	11
2e-6	8
1e-5	5

P25 SDS	
1e-4	2
1e-3	6
3e-3	4
1e-2	2

P25	
C14	
1e-5	2
3e-5	3
5e-5	1
7e-5	1
1e-4	1
3e-4	1

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P25	
C16	
1e-6	1
1e-5	4
2e-5	8
3e-5	1
5e-5	1

20

21

AluC	
SDS	
1e-5	4
1e-4	5
1e-3	3
2e-3	2
1e-2	6

22

23

AluC	
C14	
1e-5	1
3e-5	3
5e-5	1
8e-5	7
3e-4	4

24

25

AluC	
C16	
1e-5	3
3e-5	3
5e-5	5

1e-4	4
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Table S2. The pH values corresponding to the data points in Fig. 9-16

Hematite

Fig. 9

C14: 1e-6		C14: 2e-6		C14: 1e-5	
5 d aged		1 d aged		4 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
3.11	175.3	3.12	110.5	2.91	205.9
3.74	254.3	3.51	108.4	3.34	125.3
4.18	188	3.97	101.8	3.67	112.9
4.39	150	4.34	99.71	4.1	89.5
6.45	129.9	4.83	97.39	4.96	109.6
6.86	163.7	6.15	77.29	5.81	94.88
6.9	162.1	6.54	90.46	7.36	98.65
7.12	139.6	7.17	72.84	9.89	81.14
9.92	97.82	9.66	83.7	10.57	77.41
11.19	82.44	11.25	79.08		

C14: 1e-6		C14: 2e-6		C14: 1e-5	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
3.15	102.9	3.13	86.57	2.89	73.66
3.72	108.1	3.51	75.66	3.34	94.9
4.16	117.1	4.01	95.46	3.66	72
4.4	134.3	4.33	97.24	4.07	72.79
6.6	121.9	5.07	93.52	4.89	93.28
7.45	90.77	6.27	72.45	5.9	73.87
8.58	95.3	7.12	74.59	7.1	90.33
9.26	155.5	8.93	90.41	9.12	66.25
10.15	99.83	9.89	81.19	10.05	77.09
11.39	79.64	11.18	72.64	10.5	78.23

Fig. 10

C16: 1e-6		C16: 2e-6		C16: 1e-5	
11 d aged		8 d aged		5 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
3.02	190.4	3.61	117.5	6.99	187.7
3.33	169.4	3.98	135.4	9.30	132.8

3.83	132.9	4.18	121.4	5.82	129.7
4.71	140.1	6.64	165.7	8.52	144.2
5.32	116	5.5	111.6	10.33	279.2
6.51	96.14	6.19	98.18	11.01	333.8
7	108.3	6.45	81.87	5.71	80.16
9.86	92.17	6.79	79.06	3.71	178.4
11.13	114.5	8.16	121.3	3.83	154
		10.43	94.26		

C16: 1e-6		C16: 2e-6		C11: 1e-5	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
3.13	122.5	3.59	109.5	4.20	104.8
3.41	121.5	3.95	101.5	4.88	26.1
3.93	114.5	4.17	105.5	6.20	141.8
4.7	88.08	4.66	89.8	6.75	80.64
5.34	107.1	5.79	86.4	8.04	93.91
6.68	100.2	6.32	99.2	9.17	163.7
8.17	100.6	7.76	97.5	9.51	282.2
9.36	91.67	8.91	84.4	10.04	275.3
10.22	86.19	9.59	101.2	10.55	111.3
11.26	113.6	10.50	97.9	11.03	144.9

P25

Fig. 11

SDS: 1e-4		SDS: 1e-3		SDS: 1e-2	
2 d aged		6 d aged		2 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.27	1710	2.47	1714	2.33	973.1
2.98	1809	3.31	2492	3.04	858.6
4.00	996.1	4.94	2371	4.22	830
5.61	1420	5.93	1527	4.87	903.5
6.72	2021	7.31	1447	6.45	833.1
7.30	1230	7.71	1613	7.26	929.5
7.81	721.1	7.88	1457	7.73	823.8
8.27	258.3	8.04	1446	8.35	910.3
9.70	317	9.89	403.8	9.83	761.7
10.93	261.5	11.23	290.4	11.23	815.3

SDS: 1e-4	SDS: 1e-3	SDS: 1e-2
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fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.32	1490	2.31	1355	2.39	973.1
3.02	1095	3.20	1725	3.09	830
4.03	729.1	4.79	1512	4.36	833.1
5.19	667.7	5.42	1203	5.10	823.1
6.26	995.6	6.23	1447	6.01	761.7
7.07	1265	7.33	986.4	7.30	683.2
7.96	1293	8.66	390.4	8.45	750
9.52	631.5	9.86	351	9.25	777.3
10.22	281.2	10.15	353.1	10.08	608.7
11.23	299	11.29	364.2	11.37	619.6

Fig. 12

C14: 3e-5		C14: 5e-5		C14: 7e-5	
3 d aged		1 d aged		1 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
11.08	288.1	10.98	251.1	10.98	337.1
10.51	312.8	10.56	254.1	10.58	266
9.06	231.6	9.79	256.8	9.63	277.7
7.27	765.7	7.41	971	7.23	667.6
7.19	1436	6.99	784.3	6.95	718.5
6.11	932.1	6.18	933.6	6.54	918.4
5.57	987.5	5.75	752.6	5.04	986
4.78	748.6	3.77	1070	4.65	1211
3.63	1030	2.98	925.8	3.94	1451
3.05	837.4	10.98	251.1	2.88	1335

C14: 3e-5		C14: 5e-5		C14: 7e-5	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
3.03	1311	2.98	929.6	2.88	643.5
3.6	1261	3.77	1379	3.96	1163
4.85	1254	4.79	1349	4.65	1021
5.75	967.1	5.88	1308	4.98	856.2
6.54	931.1	6.62	1054	6.88	1273
7.59	729.9	7.72	933.4	7.46	922.8
8.93	369.9	8.49	355.7	9.12	351.1
9.83	282.5	9.99	279.4	9.98	312.8
10.65	317.7	10.67	300.4	10.66	339.7
11.04	308.2	11.07	262.5	11.01	303.7

Fig. 13

C16: 1e-5		C16: 2e-5		C16: 5e-5	
4 d aged		8 d aged		1 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.97	283.5	2.94	292.4	2.92	144.4
3.35	264.2	3.22	462.1	3.61	148
4.29	285.2	4.37	511.3	4.47	188.1
5.04	425.2	4.81	506.9	4.81	129.6
5.91	712.4	6.29	1128	5.78	1515
6.61	1562	6.95	668.4	6.66	1201
7	1511	7.18	2485	7.02	1001
7.35	1127	6.1	1792	8.19	195.9
10.3	159.7	8.42	337.2	9.38	171.7
10.99	149.9	9.78	176.2	11.03	172.6

C16: 1e-5		C16: 2e-5		C16: 5e-5	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.99	1174	2.96	1161	2.94	102.9
3.39	1390	3.25	1514	3.63	352.3
4.38	1066	4.77	1305	4.57	147.1
5.34	1099	5.18	1330	5.04	272.2
6.55	994.1	6.45	689.5	6.24	1055
7.11	889.6	7.45	540.6	7.27	755.6
8.84	399.3	8.71	296.6	8.38	229.5
9.63	264	9.61	227	9.66	283.2
10.52	272.6	10.25	246.4	10.52	260.1
11.03	294.3	11.01	241.2	11.11	246.3

AluC

Fig. 14

SDS: 1e-4		SDS: 1e-3		SDS: 2e-3	
5 d aged		3 d aged		2 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.24	1247	2.21	169.4	2.20	644.7
2.94	1537	3.17	547.9	3.08	950.3
3.67	3104	4.98	196.8	4.43	274.4
5.07	1750	5.75	202.1	5.63	391.4

6.15	657.3	6.93	623.3	6.75	502.1
7.13	1851	7.61	1479	7.36	930
7.75	476	8.04	1082	7.95	2362
7.93	1092	8.11	1304	8.40	1008
8.00	2197	10.24	341.3	10.18	328.6
10.55	136.2	11.62	117.4	11.67	146.9

SDS: 1e-4		SDS: 1e-3		SDS: 2e-3	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.20	1800	2.22	404.8	2.18	1500
2.89	1904	3.19	428.4	3.04	1600
3.53	1715	4.51	575.9	4.18	1307
4.75	1980	5.27	121.1	5.25	2146
5.29	1781	6.22	627.5	6.36	340.1
6.30	1227	7.28	1514	7.13	499.7
7.05	1134	8.89	947.8	8.42	1226
8.54	1681	9.17	729.5	9.08	919.7
9.09	1430	10.40	379.3	10.26	503.1
10.75	133	11.57	124.8	11.58	158.1

Fig. 15

C14: 1e-5		C14: 8e-5		C14: 3e-4	
1 d aged		7 d aged		4 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.98	478.1	2.98	1178	2.98	499.2
3.31	196	3.2	1771	3.27	347
4.4	587.2	4.22	2836	4.19	246.3
5.78	484.2	6.13	1929	6.04	273.8
6.52	754.2	6.57	465.8	6.44	119.3
7.02	885.6	7.03	1265	7.03	187.8
7.2	2574	7.2	1029	7.27	761.5
8.31	2722	7.6	782.5	7.87	2479
10.04	829.2	9.37	1002	9.68	1295
11.02	115.1	10.69	174	9.77	792.4

C14: 1e-5		C14: 8e-5		C14: 3e-4	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.94	590	2.9	307.5	2.9	118.4
3.26	471.1	3.2	453.2	3.21	110.6

4.35	1234	3.97	852	3.99	137.3
5.28	1484	5.95	711.7	5.87	130.1
6.46	1523	6.29	1933	6.49	164.8
6.96	998	7.3	806.9	7.64	1989
7.5	919.3	8.43	1020	9.13	1690
8.62	1233	9.41	1668	9.46	1938
10.33	143	10.08	969.8	10.74	168
10.95	127.9	10.89	153.1		

Fig. 16

C16: 1e-6		C16: 1e-5		C16: 3e-5	
1 d aged		3 d aged		3 d aged	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.94	590	2.94	590	2.91	1867
3.26	471.1	3.26	471.1	3.97	1184
4.35	1234	4.35	1234	4.77	1348
5.28	1484	5.28	1484	5.99	746.3
6.46	1523	6.46	1523	6.85	658
6.96	998	6.96	998	6.95	1418
7.5	919.3	7.5	919.3	7.27	898.7
8.62	1233	8.62	1233	9.21	886.3
10.33	143	10.33	143	9.75	460.2
10.95	127.9	10.95	127.9	10.88	136.9

C16: 1e-6		C16: 1e-5		C16: 3e-5	
fresh		fresh		fresh	
pH	r./ nm	pH	r./ nm	pH	r./ nm
2.94	468.7	2.89	499.9	2.91	1867
3.3	339.4	3.2	751.5	3.97	1184
4.51	351.7	4	496.6	4.77	1348
5.63	428.3	5.24	1299	5.99	746.3
6.25	789.4	6.63	1496	6.85	658
6.81	1077	7.78	1191	6.95	1418
7.49	1128	8.77	887.7	7.27	898.7
8.84	1566	9.78	758.8	9.21	886.3
10.21	180.1	11.09	133.2	9.75	460.2
10.94	131.4			10.88	136.9

Table S3. The electrophoretic mobilities (μ , in $10^{-8}\text{m}^2/\text{V/s}$) corresponding to the data points in Fig. 1-16

Hematite

C14: 1e-7		C14: 3e-7		C14: 5e-7		C14: 1e-6		C14: 2e-6		C14: 1e-5	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
2.33	1.824	2.35	1.309	2.17	0.08102	3.11	-1.68	3.12	-2.716	2.91	-1.009
3.13	3.152	3.14	-0.385	2.99	0.4711	3.74	-1.286	3.51	-1.673	3.34	-3.673
4.88	1.07	5.05	0.3718	4.93	-1.071	4.18	-2.374	3.97	-2.342	3.67	-2.247
6.18	-0.1637	6.37	-4.147	6.34	-1.79	4.39	-2.74	4.34	-2.98	4.1	-2.927
6.73	-0.3213	6.83	-4.215	7.27	-1.558	6.45	-3.182	4.83	-2.44	4.96	-2.298
7.70	-0.3311	7.54	-3.903	7.58	-1.088	6.86	-3.504	6.15	-3.224	5.81	-2.12
7.98	-0.6776	7.92	-4.753	7.97	-3.293	6.9	-3.518	6.54	-3.67	7.36	-2.847
8.47	-0.7378	8.23	-4.422	8.98	-1.971	7.12	-3.326	7.17	-3.204	9.89	-4.013
9.84	-1.762	9.54	-4.462	10.09	-2.708	9.92	-3.722	9.66	-4.197	10.57	-3.222
11.67	-1.877	11.71	-4.025	11.70	-2.092	11.19	-5.053	11.25	-4.043		

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C16: 3e-8		C16: 5e-8		C16: 1e-6		C16: 2e-6		C16: 1e-5	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
2.29	0.7521	2.32	0.2578	3.02	-2.131	3.61	-3.132	2.91	-1.009
3.08	1.528	3.11	1.715	3.33	-2.324	3.98	-3.788	3.34	-3.673
4.22	1.5	5.01	0.3421	3.83	-2.874	4.18	-3.586	3.67	-2.247
6.49	-0.1362	6.21	-0.2827	4.71	-2.712	4.64	-3.981	4.1	-2.927
6.81	-0.2402	6.72	-0.1574	5.32	-3.565	5.5	-3.969	4.96	-2.298
7.30	-0.6254	7.52	-0.2583	6.31	-4.166	6.19	-3.6	5.81	-2.12
7.93	-1.052	7.99	-0.4138	6.32	-4.277	6.45	-3.548	7.36	-2.847
8.22	-1.338	8.69	-0.4495	6.51	-4.279	6.79	-4.61	9.89	-4.013
10.12	-2.482	10.06	-2.258	7	-4.11	8.16	-4.577	10.57	-3.222
11.61	-2.043	11.62	-1.925	9.86	-4.61	10.43	-4.341		

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p25

None		SDS: 1e-4		SDS: 1e-3		SDS: 1e-2	
pH	μ	pH	μ	pH	μ	pH	μ
2.99	2.893	2.27	1.917	2.47	-2.847	2.33	-4.043
3.36	2.716	2.98	1.741	3.31	-2.476	3.04	-3.22
4.57	2.295	4.00	2.296	4.94	-1.518	4.22	-3.332
5.19	1.458	5.61	0.9542	5.93	0.1202	4.87	-3.375
5.38	0.9009	6.72	-0.6545	7.31	-0.8405	6.45	-3.316
6.44	-0.2334	7.30	-1.529	7.71	-1.092	7.26	-3.489
6.82	-0.9665	7.81	-2.048	7.88	-2.068	7.73	-3.312
7.82	-2.268	8.27	-2.244	8.04	-1.916	8.35	-3.253
9.09	-3.011	9.70	-3.42	9.89	-3.439	9.83	-3.599

		10.93	-3.837	11.23	-3.716	11.23	-3.742
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None		C14: 1e-5		C14: 3e-5		C14: 5e-5		C14: 7e-5		C14: 1e-4	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
2.99	2.893	10.8	-3.349	11.04	-3.253	10.98	-3.474	10.98	-3.481	10.98	-3.581
3.36	2.716	10.09	-3.277	10.65	-3.089	10.56	-3.352	10.58	-3.44	10.58	-3.32
4.57	2.295	8.36	-1.814	9.83	-2.211	9.79	-2.993	9.63	-3.218	9.63	-2.821
5.19	1.458	7.05	-0.07882	7.59	-0.6208	7.41	-1.106	7.23	-0.7205	7.23	0.08734
5.38	0.9009	6.86	0.2079	6.54	0.173	6.99	0.04502	6.95	-0.6455	6.95	0.1258
6.44	-0.2334	5.43	2.22	5.75	1.068	6.18	1.17	6.54	0.6768	6.54	-0.5578
6.82	-0.9665	4.36	2.742	4.85	1.497	5.75	1.752	5.04	0.7024	5.04	-1.097
7.82	-2.268	3.88	2.972	3.60	1.689	3.77	1.43	4.65	0.03631	4.65	-2.243
9.09	-3.011	3.59	3.012	3.03	1.884	2.98	1.603	3.94	-0.6601	3.94	-2.572
		3.16	3.137					2.88	-1.799	2.88	-2.838

None		C16: 1e-6		C16: 1e-5		C16: 2e-5		C16: 5e-5	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
2.99	2.893	11.06	-4.149	2.97	3.018	2.94	2.893	2.92	-2.683
3.36	2.716	10.56	-4.094	3.35	2.614	3.22	2.64	3.61	-2.762
4.57	2.295	9.65	-3.802	4.29	2.036	4.37	1.496	4.47	-2.622
5.19	1.458	7.23	-0.8948	5.04	1.802	4.81	1.894	4.81	-2.873
5.38	0.9009	6.81	-0.169	5.91	0.2876	6.1	-0.00932	5.78	-2.465
6.44	-0.2334	6.07	1.273	6.61	-1.147	6.29	-0.8558	6.66	-1.973
6.82	-0.9665	4.95	2.475	7	-0.7094	6.95	-1.257	7.02	-2.275
7.82	-2.268	3.82	2.895	7.35	-1.853	7.18	-1.516	8.19	-2.204
9.09	-3.011	3.43	2.916	10.3	-3.381	8.42	-2.568	9.38	-3.198
		3.03	3.004	10.99	-3.392	9.78	-3.228	11.03	-3.301

AluC

None		SDS: 1e-5		SDS: 1e-4		SDS: 1e-3		SDS: 2e-3	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
3.03	3.319	2.31	3.107	2.24	-0.446	2.21	-1.43	2.20	-2.021
3.42	3.161	2.90	3.136	2.94	-0.6292	3.17	-1.383	3.08	-1.823
4.36	3.154	3.78	3.437	3.67	-0.209	4.98	-0.8005	4.43	-2.145
5.81	3.082	5.10	3.119	5.07	0.3274	5.75	-2.458	5.63	-2.583
6.56	2.936	5.66	3.072	6.15	1.84	6.93	-1.921	6.75	-2.722
6.95	2.578	6.95	2.597	7.13	1.722	7.61	-0.3021	7.36	-2.146
7.28	2.434	7.68	1.732	7.75	1.032	8.04	0.01134	7.95	-1.466

8.92	0.679	7.81	1.125	7.93	1.014	8.11	0.07702	8.40	-0.7336
10.47	-1.915	8.98	-0.6897	8.00	0.7021	10.24	-1.81	10.18	-1.845
10.78	-2.319	10.23	-2.493	10.55	-2.427	11.62	-2.399	11.67	-2.439

None		C14: 1e-5		C14: 3e-5		C14: 5e-5		C14: 8e-5		C14: 3e-4	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
3.03	3.319	2.98	3.148	2.92	0.7514	2.9	-0.8878	2.98	-1.066	2.98	-1.925
3.42	3.161	3.31	2.935	3.23	0.3637	3.22	-0.9145	3.3	-1.154	3.27	-1.931
4.36	3.154	4.4	3.07	4.21	0.2854	4.15	-0.9335	4.22	-1.062	4.19	-2.193
5.81	3.082	5.78	2.565	6.04	-0.7054	5.6	-1.692	6.13	-1.451	6.04	-2.553
6.56	2.936	6.52	2.341	6.61	0.4156	6.64	-0.7273	6.57	-1.534	6.44	-2.699
6.95	2.578	7.02	1.85	7	0.4196	7.11	0.1066	7.03	-1.225	7.03	-1.868
7.28	2.434	7.2	2.646	7.56	1.17	8.02	0.8431	7.2	-0.7314	7.27	-2.51
8.92	0.679	8.31	1.561	7.86	1.232	10.25	-2.504	7.6	-0.6909	7.87	-1.559
10.47	-1.915	10.04	-1.49	9.9	-2.272	10.94	-3.204	9.37	-0.6072	9.68	-1.57
10.78	-2.319	11.02	-2.519	10.85	-3.215			10.69	-2.677	9.77	-1.524

None		C16: 1e-5		C16: 3e-5		C16: 5e-5		C16: 1e-4	
pH	μ	pH	μ	pH	μ	pH	μ	pH	μ
3.03	3.319	2.94	3.24	2.91	2.853	2.92	1.137	2.88	-1.138
3.42	3.161	3.26	3.115	3.97	2.475	3.25	0.4951	3.36	-0.9831
4.36	3.154	4.35	3.068	4.77	2.538	4.56	0.6933	4.17	-1.644
5.81	3.082	6.46	2.458	5.99	1.461	5.7	-0.8116	6.46	-3.032
6.56	2.936	6.96	1.88	6.85	1.366	6.53	-2.215	5.84	-3.134
6.95	2.578	7.5	1.079	6.95	0.6648	7	-2.363	7.07	-3.356
7.28	2.434	8.62	1.229	7.27	1.032	7.35	-1.861	7.79	-2.965
8.92	0.679	10.33	-2.289	9.21	-0.1232	8.25	-1.28	8.84	-2.811
10.47	-1.915	10.95	-2.861	9.75	-1.039	10.22	-2.545	10.06	-2.431
10.78	-2.319			10.88	-2.867	10.94	-3.235	10.91	-3.618