Anticorrosion performance of magnesium hydroxide coatings on steel substrates

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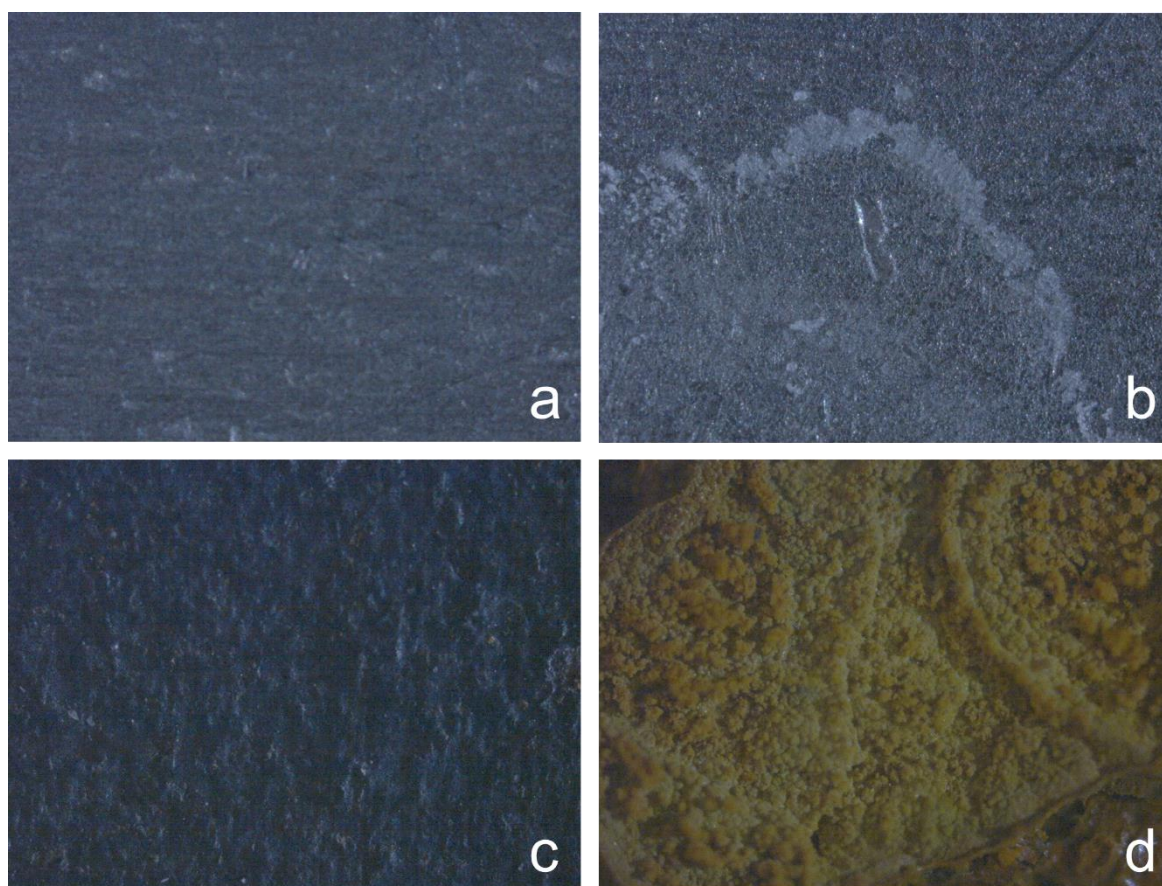*   Correspondence: zoubouli@chem.auth.gr

Figure S1. Surface observations, by using an optical microscope, of uncoated stainless steel specimens: (a) before, and (b) after 4 days of sulfuric acid spraying test, and of uncoated mild steel specimens: (c) before, and (d) after 4 days of acid spraying test.
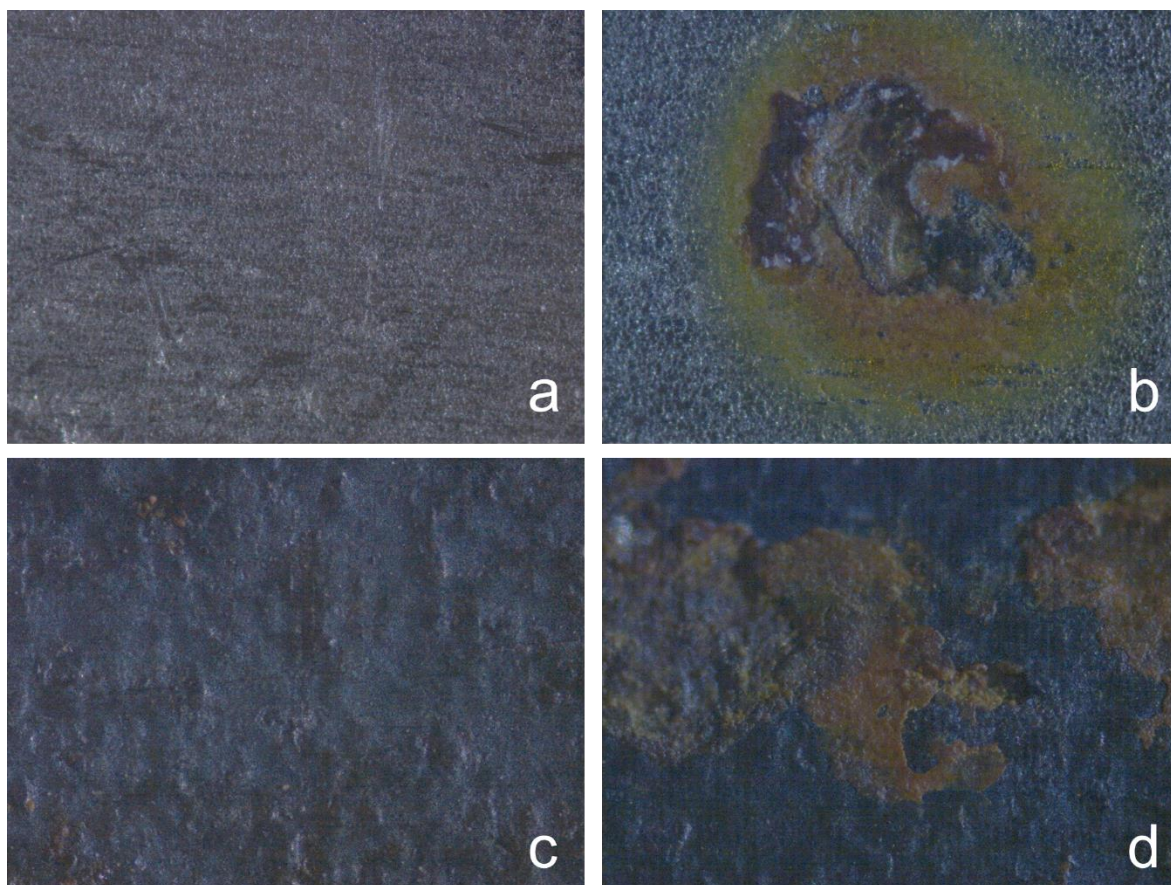
Figure S2. Surface observations, by using an optical microscope, of the stainless steel specimens coated with: (a) C6, and (b) C2 coatings, and of the mild steel specimens coated with: (c) C6, and (d) C2 coatings; after 4 days of sulfuric acid spraying test and after removing the coatings for all the specimens.

Table S1 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the uncoated stainless-steel specimens.

Spraying days / Parameter	Uncoated			
	1	2	3	4
R_s (Ω cm²)	17.05	15.12	26.26	36.92
Q_f (S cm^{-2} s^n)	5.26E-05	6.90E-05	6.50E-05	1.15E-04
n	0.92	0.87	0.87	1.00
R_f (Ω cm²)	7.80E+04	3.57E+04	7.98E+07	1.16E+07
Q_{dl} (S cm-2 sn)	2.27E-03	2.58E-04	6.72E-02	1.72E-04
n	0.52	0.74	0.81	0.81
R_{ct} (Ω cm²)	2.50E+04	1.77E+03	1.23E+03	3.57E+04
Chi-squared	4.01E-05	3.86E-04	2.05E-03	6.85E-04

Table S2 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C1.

C1				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	3.84E-02	3.15E+01	4.84E-05	3.40E-01
Q_{coat} (S cm⁻² sⁿ)	1.90E-04	7.97E-03	1.34E-04	2.41E-03
n	0.06	0.36	0.00	0.96
R_{coat} (Ω cm²)	3.22E+01	1.11E+05	3.95E+01	2.52E+03
Q_{dl} (S cm-2 sn)	2.80E-05	2.63E-05	2.80E-05	2.17E-02
n	0.90	0.93	0.91	0.83
R_{ct} (Ω cm²)	3.80E+07	3.20E+16	3.64E+08	4.31E-01
Chi-squared	1.84E-03	3.17E-04	1.40E-03	7.72E-04

Table S3 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C2.

C2				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	31.68	26.86	33.85	3.05E-07
Q_{coat} (S cm⁻² sⁿ)	1.85E-02	1.58E-02	2.30E-04	3.89E-03
n	0.2813	0.244	0.7143	0.916
R_{coat} (Ω cm²)	3.02E+01	9.12E+13	1.94E+03	9.70E+09
Q_{dl} (S cm-2 sn)	2.90E-05	2.69E-05	2.50E-05	2.05E+00
n	0.9072	0.935	0.9927	0.0261
R_{ct} (Ω cm²)	2.00E+06	5.40E+15	1.51E+05	2.85E+01
Chi-squared	3.80E-04	4.02E-05	2.89E-04	7.10E-04

Table S4 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C3.

C3				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	2.93E-01	3.15E-01	3.05E-07	3.02E-01
Q_{coat} (S cm⁻² sⁿ)	2.88E-03	2.59E-03	2.64E-03	7.35E+06
n	0.92	0.90	0.92	0.45
R_{coat} (Ω cm²)	1.02E+08	1.62E+09	9.74E+09	5.06E-03
Q_{dl} (S cm-2 sn)	1.44E-01	9.18E+04	1.90E+00	2.93E-03
n	0.59	0.98	0.03	0.89
R_{ct} (Ω cm²)	3.09E-01	3.05E-07	9.73E+03	2.86E+08
Chi-squared	2.00E-04	1.50E-03	1.39E-04	1.21E-03

Table S5 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C4.

	C4			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	3.05E-07	2.83E-04	3.24E-01	2.81E-01
Q_{coat} (S cm^{-2} s^n)	2.58E-03	2.24E+00	1.03E-04	2.96E-03
n	0.90	0.03	0.00	0.88
R_{coat} (Ω cm²)	3.70E+09	1.03E+04	3.05E-07	3.14E+08
Q_{dl} (S cm-2 sn)	2.02E+00	2.44E-03	2.91E-03	5.50E-03
n	0.03	0.93	0.90	0.91
R_{ct} (Ω cm²)	2.08E+02	1.27E+14	1.60E+10	7.83E+01
Chi-squared	1.18E-04	1.47E-04	8.07E-04	3.22E-04

Table S6 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C5.

	C5			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	0.28	0.34	0.32	0.34
Q_{coat} (S cm^{-2} s^n)	1.42E-05	3.06E-03	2.93E-03	3.09E-03
n	0.00	0.88	0.89	0.89
R_{coat} (Ω cm²)	1.24E-08	6.00E+05	1.37E+09	1.20E+05
Q_{dl} (S cm-2 sn)	3.28E-03	3.23E-02	1.60E+02	7.86E-02
n	0.88	1.00	0.03	0.58
R_{ct} (Ω cm²)	3.34E+08	2.85E+01	7.40E-14	1.78E-01
Chi-squared	2.22E-03	9.96E-04	2.94E-02	5.80E-05

Table S7 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C6.

	C6			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	20.47	17.22	25.45	39.09
Q_{coat} (S cm^{-2} s^n)	1.00E-03	8.04E-03	4.00E-03	3.44E-05
n	0.65	0.43	0.46	0.94
R_{coat} (Ω cm²)	9.22E+00	1.44E+04	2.24E+01	4.02E+05
Q_{dl} (S cm-2 sn)	2.46E-05	3.71E-05	2.90E-05	0.00025
n	0.92	0.92	0.94	0.70
R_{ct} (Ω cm²)	1.84E+11	3.08E+05	3.78E+09	1.44E+10
Chi-squared	9.22E-05	4.77E-05	3.55E-05	1.96E-04

Table S8 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C7.

	C7			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	5.01	17.99	25.85	39.22
Q_{coat} (S cm^{-2} s^n)	2.80E-05	1.71E-04	1.07E-02	2.45E-05
n	0.91	1.00	0.31	0.99
R_{coat} (Ω cm²)	1.90E+06	3.57E+07	2.90E+23	1.91E+05
Q_{dl} (S cm-2 sn)	1.80E-06	3.55E-05	3.21E-05	0.000245
n	0.72	0.89	0.90	0.68
R_{ct} (Ω cm²)	1.87E+01	5.73E+05	4.72E+08	2.25E+03
Chi-squared	6.36E-04	1.10E-03	8.41E-05	3.59E-04

Table S9 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated stainless-steel specimens with coating C8.

	C8			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	1.80E-01	4.22E-01	6.66E-10	3.43E-01
Q_{coat} (S cm^{-2} s^n)	1.87E+00	4.21E-03	3.72E-03	3.27E-03
n	0.15	0.83	0.83	0.91
R_{coat} (Ω cm²)	4.70E+05	8.05E+02	1.74E+08	6.36E+02
Q_{dl} (S cm-2 sn)	0.0027	3.61E-07	9.20E-13	0.2457
n	0.90	1.00	0.00	0.18
R_{ct} (Ω cm²)	2.31E+00	5.96E-02	6.19E-01	2.04E+03
Chi-squared	2.28E-04	6.34E-03	1.34E-02	5.68E-04

Table S10 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the uncoated mild steel specimens.

	Uncoated			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	47.80	19.20	33.04	19.35
Q_f (S cm^{-2} s^n)	1.244	0.033	0.024	0.010
n	1.00	0.32	0.53	0.34
R_f (Ω cm²)	4.84E-08	3291	5.80E+08	4.88E+08
Q_{dl} (S cm-2 sn)	5.79E-03	4.66E+01	4.23E-01	5.54E-12
n	0.54	1.00	0.01	0.22
R_{ct} (Ω cm²)	2.14E+05	1.10E-03	4.48E-14	3.04E+07
Chi-squared	3.25E-05	5.56E-05	5.98E-05	5.85E-03

Table S11 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C1.

C1				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	43.99	57.39	40.86	39.17
Q_{coat} (S cm⁻² sⁿ)	7.35E-05	0.001	3.03E-07	0.002
n	0.82	0.00	0.79	0.62
R_{coat} (Ω cm²)	0.012	0.035	0.114	3.58E-16
Q_{dl} (S cm-2 sn)	1.71E-03	2.90E-03	1.20E-03	4.70E-04
n	0.51	0.48	0.57	0.00
R_{ct} (Ω cm²)	3.35E+03	4.20E+03	2.39E+03	9.97E+14
Chi-squared	5.36E-05	6.44E-05	1.25E-04	1.94E-04

Table S12 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C2.

C2				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	29.08	48.56	42.74	87.17
Q_{coat} (S cm⁻² sⁿ)	5.08E-07	1.60E-03	2.28E-03	1.76E-09
n	0.54	0.91	0.59	0.00
R_{coat} (Ω cm²)	3	79800	84	0
Q_{dl} (S cm-2 sn)	1.71E-03	7.37E-04	1.28E-08	3.90E-03
n	0.56	0.62	0.97	0.59
R_{ct} (Ω cm²)	3.28E+03	5.52E+02	1.22E+03	1.03E+08
Chi-squared	3.80E-05	7.31E-05	5.18E-05	5.27E+05

Table S13 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C3.

C3				
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	1.24	0.37	0.42	1.88
Q_{coat} (S cm⁻² sⁿ)	0.162	0.099	0.150	0.145
n	0.58	0.53	0.56	0.68
R_{coat} (Ω cm²)	45.98	9.58E-07	4.00E-04	9.40
Q_{dl} (S cm-2 sn)	4.14E-10	1.26E-01	1.36E-08	8.56E-04
n	1.00	0.52	0.09	0.08
R_{ct} (Ω cm²)	2.38E-03	2.42E+01	2.10E+01	1.34E-03
Chi-squared	1.91E-05	5.52E-05	0.000105	4.67E-05

Table S14 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C4.

	C4			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	2.31E-15	1.50	0.06	3.65E-06
Q_{coat} (S cm^{-2} s^n)	0.125	0.035	0.066	0.053
n	0.57	0.00	0.04	0.15
R_{coat} (Ω cm²)	22.27	3.96E-05	0.30	0.42
Q_{dl} (S cm-2 sn)	1.40E-18	8.46E-02	2.14E-01	1.95E-01
n	0.00	0.59	0.58	0.61
R_{ct} (Ω cm²)	5.21E-01	9.43E+01	2.53E+02	3.19E+01
Chi-squared	5.86E-05	6.61E-05	4.75E-05	2.58E-04

Table S15 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C5.

	C5			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	1.39	0.05	0.00	0.10
Q_{coat} (S cm^{-2} s^n)	0.237	0.098	0.084	0.218
n	0.55	0.58	0.59	0.54
R_{coat} (Ω cm²)	4272	26	15	244000
Q_{dl} (S cm-2 sn)	2.70E-06	9.50E-07	5.26E-04	3.84E-01
n	0.00	0.64	0.00	0.03
R_{ct} (Ω cm²)	7.85E-06	1.11E+00	3.16E-01	7.90E-01
Chi-squared	1.51E-05	4.35E-05	1.47E-04	6.98E-05

Table S16 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C6.

	C6			
Spraying days / Parameter	1	2	3	4
R_s (Ω cm²)	23.22	20.30	29.72	130.70
Q_{coat} (S cm^{-2} s^n)	0.024	0.002	0.001	1.12E-09
n	0.76	0.56	0.55	0.25
R_{coat} (Ω cm²)	960	108	527	9
Q_{dl} (S cm-2 sn)	9.30E-04	2.80E-12	2.76E-03	2.36E-03
n	0.57	0.02	1.00	0.49
R_{ct} (Ω cm²)	9.99E+02	1.16E+03	5.26E+02	7.34E+06
Chi-squared	4.66E-04	1.50E-04	1.06E-04	1.27E-03

Table S17 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C7.

C7				
Spraying days Parameter	1	2	3	4
R_s (Ω cm²)	23.03	32.44	29.18	40.37
Q_{coat} (S cm⁻² sⁿ)	0.001	56.120	0.002	0.117
n	0.55	0.87	0.52	0.73
R_{coat} (Ω cm²)	1377	1	1322	53
Q_{dl} (S cm-2 sn)	2.29E-07	1.71E-03	6.89E-03	1.31E-03
n	0.90	0.53	1.00	0.54
R_{ct} (Ω cm²)	2.43E+02	3.18E+03	1.30E+04	1.54E+03
Chi-squared	2.58E-04	1.02E-04	1.70E-04	2.31E-04

Table S18 Parameter values of the equivalent circuit that result from the fitting of the experimental data of the coated mild steel specimens with coating C8.

C8				
Spraying days Parameter	1	2	3	4
R_s (Ω cm²)	0.37	0.49	0.67	4.26
Q_{coat} (S cm⁻² sⁿ)	0.104	4.43E-10	0.139	0.126
n	0.56	0.00	0.49	0.44
R_{coat} (Ω cm²)	7.43E-05	2.98E-06	3.68E-17	9.49E+03
Q_{dl} (S cm-2 sn)	2.65E-10	8.71E-02	1.00E-22	3.24E-16
n	0.00	0.52	0.20	0.03
R_{ct} (Ω cm²)	266.7	1.64E+08	1.02E+08	6.31E-07
Chi-squared	1.38E-04	1.89E-04	3.97E-04	8.21E-05