

## Electronic Supplementary Information (ESI)

# **9-Substituted acridines as effective corrosion inhibitors for mild steel: Electrochemical, surface morphology and computational studies**

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## FIGURES

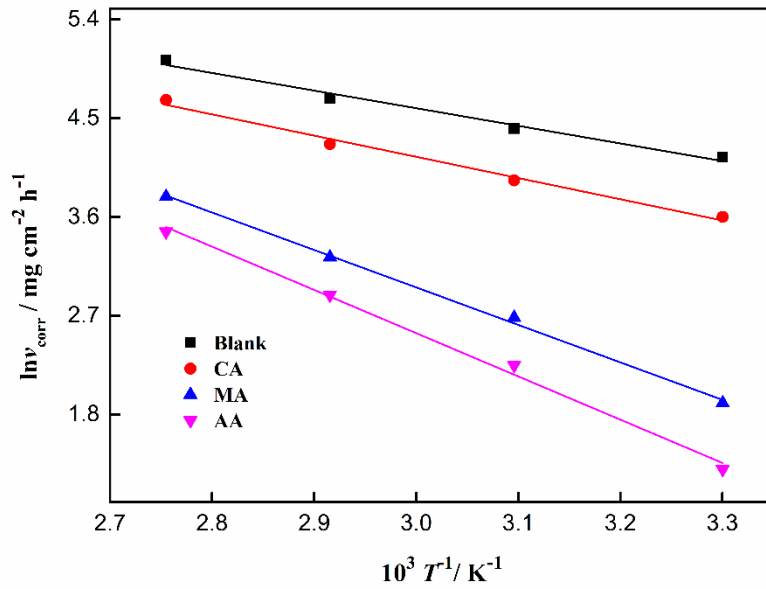


Fig. S1. Arrhenius plots of  $\ln v_{\text{corr}}$  vs.  $1/T$  for steel in 15% HCl in the absence and presence of inhibitors.

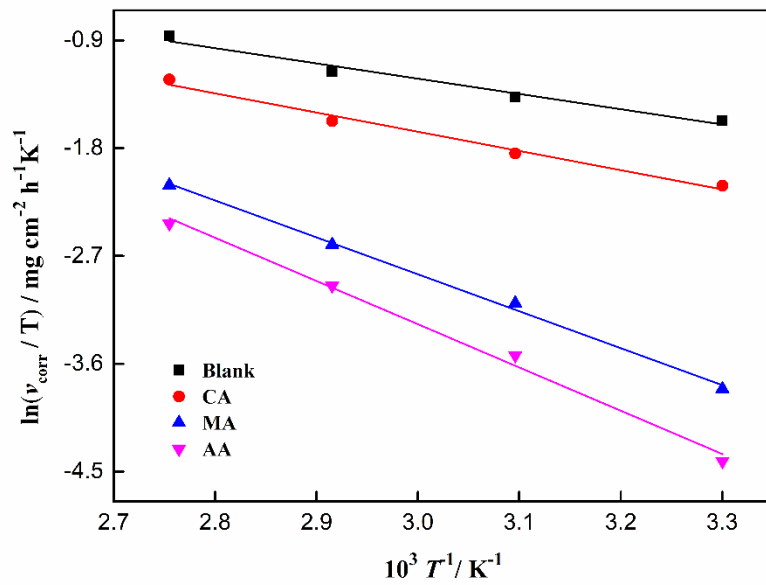
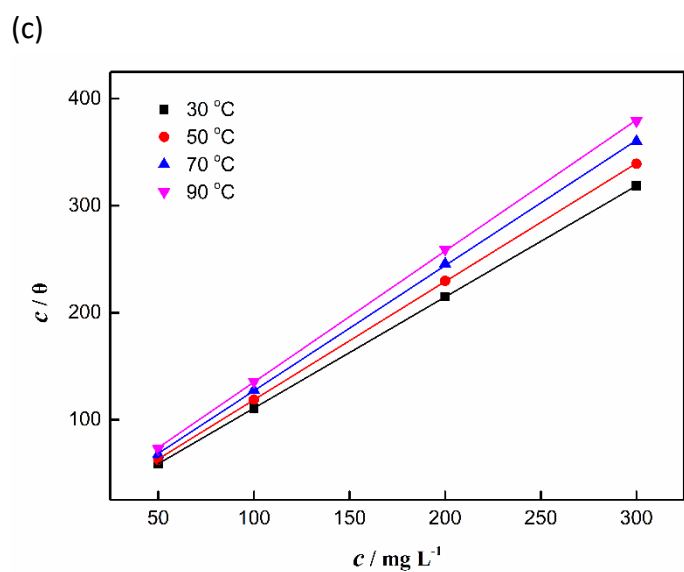
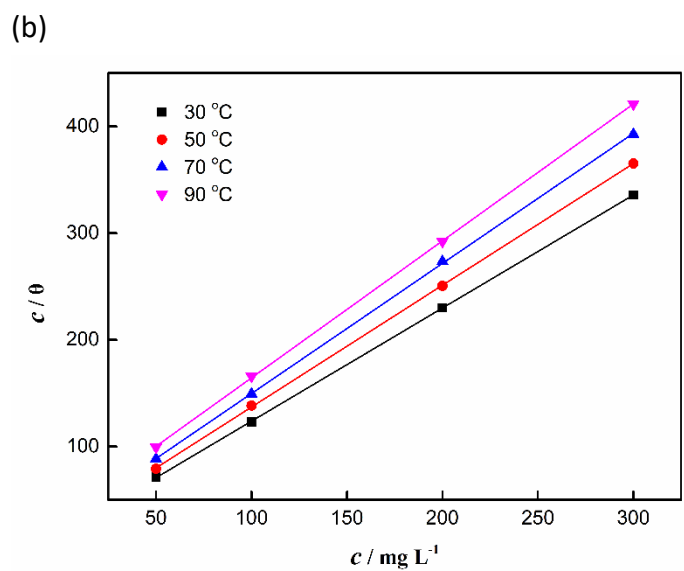
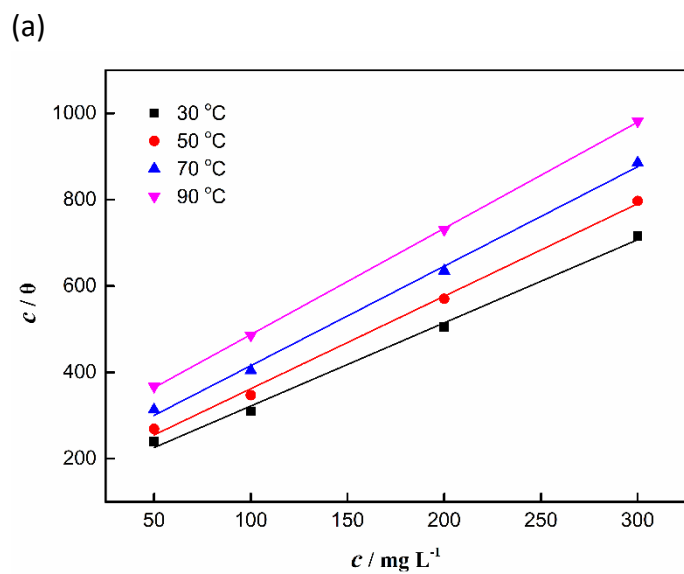
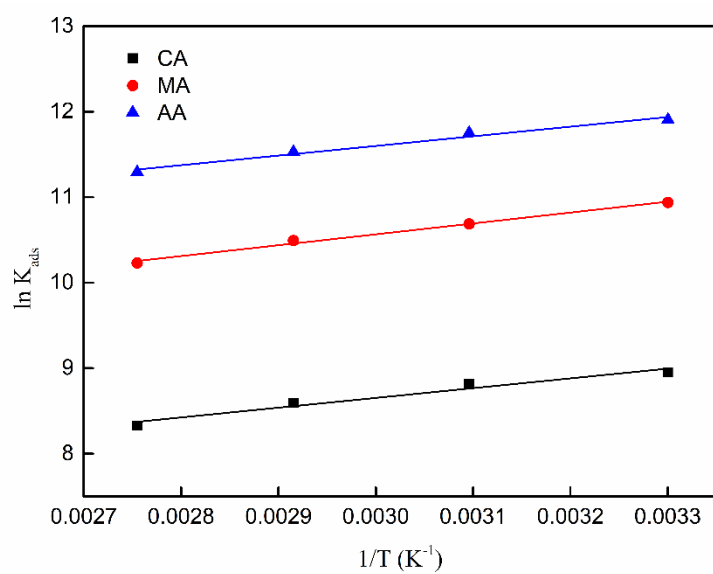


Fig. S2. Arrhenius plots of  $\ln(v_{\text{corr}}/T)$  vs.  $1/T$  for steel in 15% HCl in the absence and presence of inhibitors.

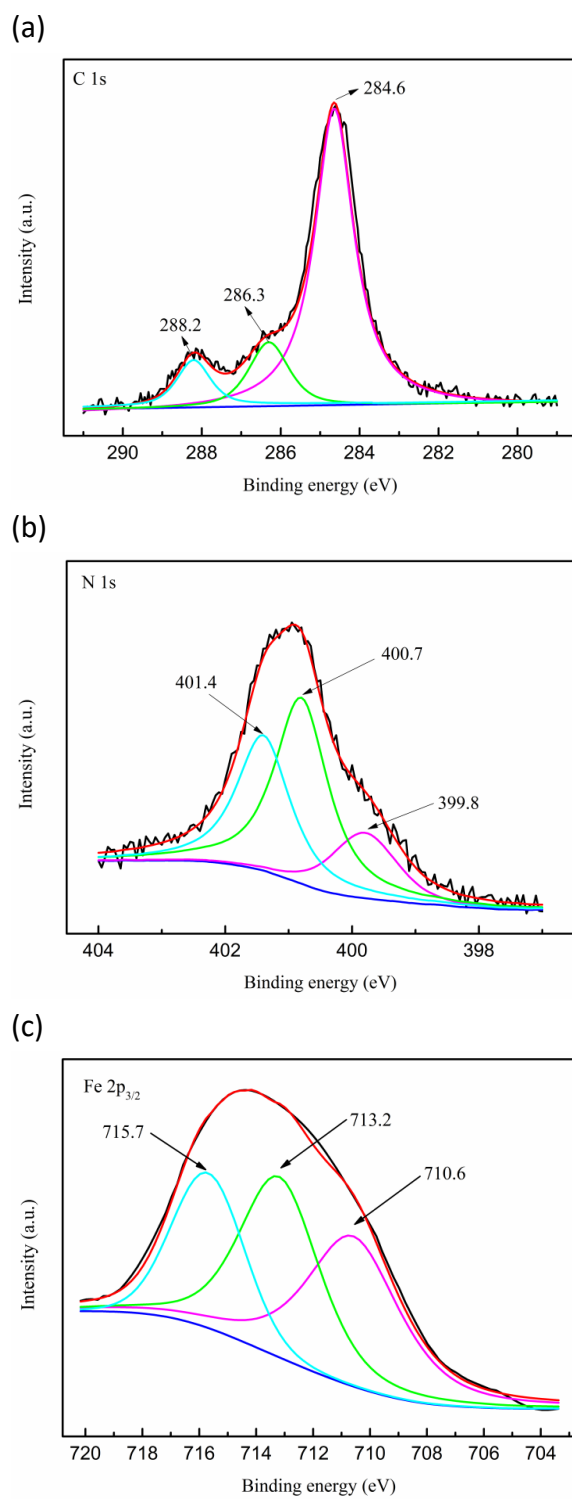


**Fig. S3.** Langmuir adsorption plots for mild steel in 15% HCl solution containing (a) CA, (b) MA and (c) AA at 30–90 °C.



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**Fig. S4.** Plot of  $\ln K_{\text{ads}}$  vs.  $1/T$  for mid steel in 15% HCl solution containing CA, MA and AA at 30–90 °C.



**Fig. S5.** High-resolution XPS spectra of (a) C 1s, (b) N 1s, and (c) Fe 2p<sub>3/2</sub> for AA treated mild steel.

## TABLES

**Table S1** Chemical composition of the steel grades.

Steel	Chemical composition (wt.%)
MS	C (0.047), Mn (0.150), Si (0.190), P (0.028), S (0.008), Fe (balance)
J55	C (0.241), Mn (1.103), Si (0.224), P (0.103), S (0.004), Ni (0.281), Mo (0.019), Fe (balance)
X80	C (0.066), Mn (1.582), Si (0.240), P (0.011), S (0.003), Cr (0.022), Nb (0.056), V (0.005), Ti (0.024), B (0.0006), Fe (balance)

**Table S2** Calculated corrosion rate and inhibition efficiency for corrosion of MS, J55 and X80 in 15% HCl with inhibitors at 30 °C.

Inhibitor/ C (ppm)	MS		J55		X80		
	$v$ (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	$v$ (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	$v$ (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	
	Blank	0.0	63.05	-	94.58	78.81	
CA	50	49.88	20.89	77.98	17.55	63.83	19.01
	100	42.70	32.27	69.10	26.94	55.92	29.04
	200	38.11	39.56	63.53	32.83	51.06	35.21
	300	36.61	41.93	61.86	34.59	49.74	36.89
MA	50	18.77	70.23	38.79	58.99	28.44	63.91
	100	11.82	81.25	30.42	67.84	21.18	73.13
	200	8.21	86.98	26.30	72.19	17.80	77.41
	300	6.71	89.36	23.91	74.72	15.26	80.64
AA	50	9.49	84.95	31.82	66.36	21.03	73.32
	100	5.96	90.54	24.96	73.61	16.16	79.49
	200	4.40	93.02	21.51	77.26	13.57	82.78
	300	3.67	94.18	19.11	79.79	12.24	84.47

**Table S3** Polarization curve parameters for the corrosion of mild steel in 15% HCl solution without and with different concentrations of inhibitors.

Inhibitors	<i>c</i> (mg/L)	<i>E</i> <sub>corr</sub> (mV vs.SCE)	<i>i</i> <sub>corr</sub> (μA cm <sup>-2</sup> )	<i>β</i> <sub>a</sub> (mV dec <sup>-1</sup> )	- <i>β</i> <sub>c</sub> (mV dec <sup>-1</sup> )	<i>η</i> (%)
-	Blank	-457	1595	103.2	136.4	-
CA	50	-463	1207	112.7	148.6	24.3
	100	-470	1007.2	101.1	130.7	36.85
	200	-468	935.2	102.3	134.1	41.37
	300	-473	882.0	106.8	140.9	44.70
	50	-471	472.9	101.0	118.9	70.35
MA	100	-476	287.4	89.5	126.0	81.98
	200	-480	163.0	82.5	120.8	89.78
	300	-484	128.1	85.4	127.7	91.97
	50	-476	243.4	86.1	124.9	84.74
AA	100	-480	151.2	84.8	128.7	90.52
	200	-483	106.0	88.6	130.5	93.35
	300	-486	76.6	89.4	137.6	95.20

**Table S4** EIS parameters for the corrosion of mild steel in 15% HCl solution without and with different concentrations of inhibitors.

Inhibitors	<i>c</i> (mg/L)	<i>R</i> <sub>f</sub> (Ω cm <sup>2</sup> )	<i>R</i> <sub>ct</sub> (Ω cm <sup>2</sup> )	<i>C</i> <sub>f</sub> (n <sub>1</sub> ) (μF cm <sup>-2</sup> )	<i>C</i> <sub>d</sub> (n <sub>2</sub> ) (μF cm <sup>-2</sup> )	<i>R</i> <sub>p</sub> (Ω cm <sup>2</sup> )	<i>χ</i> <sup>2</sup> (10 <sup>-3</sup> )	<i>η</i> <sub>z</sub> (%)
-	Blank	-	41.8	-	738.1 (0.86)	41.8	3.05	-
CA	50	-	53.9	-	371.4 (0.82)	53.9	8.41	22.45
	100	-	67.2	-	278.1 (0.83)	67.2	6.21	37.80
	200	-	73.7	-	243.4 (0.86)	73.7	8.85	43.28
	300	-	77.2	-	213.4 (0.86)	77.2	7.11	45.85
	50	9.2	139.8	47.5 (1)	163.5 (0.71)	149.0	1.53	71.95
MA	100	13.6	234.9	36.8 (1)	118.5 (0.72)	248.5	1.77	83.18
	200	28.9	401.8	27.8 (1)	79.7 (0.69)	430.7	3.92	90.29
	300	34.2	498.9	23.9 (1)	63.6 (0.68)	533.1	1.65	92.16
	50	4.6	306.1	34.4 (1)	99.6 (0.72)	310.7	4.66	86.55
AA	100	10.0	484.3	25.8 (1)	72.6 (0.69)	494.3	6.74	91.54
	200	30.4	646.8	20.6 (1)	47.7 (0.70)	677.2	8.63	93.83
	300	26.8	909.4	16.2 (1)	45.9 (0.68)	936.2	2.16	95.54

**Table S5** Weight loss results of mild steel in 15% HCl with inhibitors at different temperatures.

Inhibitor/ <i>C</i> (ppm)	30 °C		50 °C		70 °C		90 °C		
	<i>v</i> (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	<i>v</i> (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	<i>v</i> (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	<i>v</i> (mg cm <sup>-2</sup> h <sup>-1</sup> )	$\eta_w$ (%)	
Blank	0.0	63.05	-	81.86	-	107.57	-	153.15	-
CA	50	49.88	20.89	66.66	18.57	90.42	15.94	132.31	13.61
	100	42.70	32.27	58.29	28.79	80.98	24.72	121.62	20.59
	200	38.11	39.56	53.18	35.04	73.71	31.48	111.23	27.37
	300	36.61	41.93	51.06	37.63	71.11	33.89	106.36	30.55
MA	50	18.77	70.23	30.09	63.24	46.67	56.61	76.01	50.37
	100	11.82	81.25	22.67	72.31	35.51	66.99	60.77	60.32
	200	8.21	86.98	16.51	79.83	28.85	73.18	48.29	68.47
	300	6.71	89.36	14.63	82.13	25.35	76.43	44.03	71.25
AA	50	9.49	84.95	16.49	79.85	27.69	74.26	47.95	68.69
	100	5.96	90.54	13.01	84.11	23.26	78.38	40.13	73.80
	200	4.40	93.02	10.61	87.04	19.96	81.44	34.99	77.15
	300	3.67	94.18	9.47	88.43	17.97	83.29	31.98	79.12

**Table S6** Thermodynamic parameters of inhibitors on the mild steel surface in 15% HCl solution.

Compounds	<i>T</i> (°C)	<i>R</i> <sup>2</sup>	<i>K</i> <sub>ads</sub> (10 <sup>3</sup> )	$\Delta G^0_{ads}$ (kJ mol <sup>-1</sup> )	$\Delta H^0_{ads}$ (kJ mol <sup>-1</sup> )	$\Delta S^0_{ads}$ (J mol <sup>-1</sup> )
CA	30	0.9947	7.72	-22.55	-9.48	158.38
	50	0.9956	6.76	-23.68		
	70	0.9963	5.40	-24.51		
	90	0.9947	4.14	-25.14		
MA	30	0.9999	56.32	-27.56	-10.57	171.01
	50	0.9999	43.77	-28.70		
	70	0.9998	36.03	-29.92		
	90	0.9999	27.76	-30.88		
AA	30	0.9999	147.73	-29.99	-9.35	183.23
	50	0.9999	126.76	-31.55		
	70	0.9998	101.44	-32.87		
	90	0.9998	80.06	-34.07		