

## Electronic Supplementary Information

### Comparison of Synergistic Effect of Counterions on Corrosion Inhibition for Mild Steel in Acid Solution: Electrochemical, Gravimetric and Thermodynamic Studies

Li Bai<sup>a</sup>, La-Jun Feng<sup>a</sup>, Hong-Yan Wang<sup>b\*</sup>, Yong-Bin Lu<sup>c</sup>, Xiao-Wei Lei<sup>d</sup>, Fang-Lin Bai<sup>c</sup>

<sup>a</sup> School of Materials Science and Engineering, Xi'an University of Technology, Xi'an 710048, P.R. China

<sup>b</sup> School of Chemistry and Chemical Engineering, Shaanxi Normal University, Xi'an 710119, P. R. China

<sup>c</sup> Research Institute of Yanchang Petroleum (Group) CO. LTD, Xi'an 710075, P.R. China

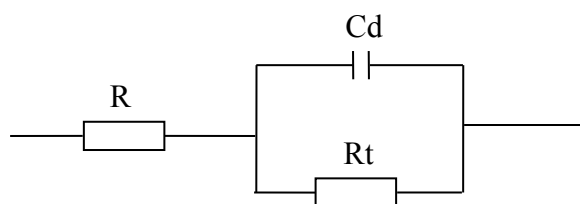
<sup>d</sup> State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an 710049, P.R. China

Corresponding author. Tel.: +46 0729428391.

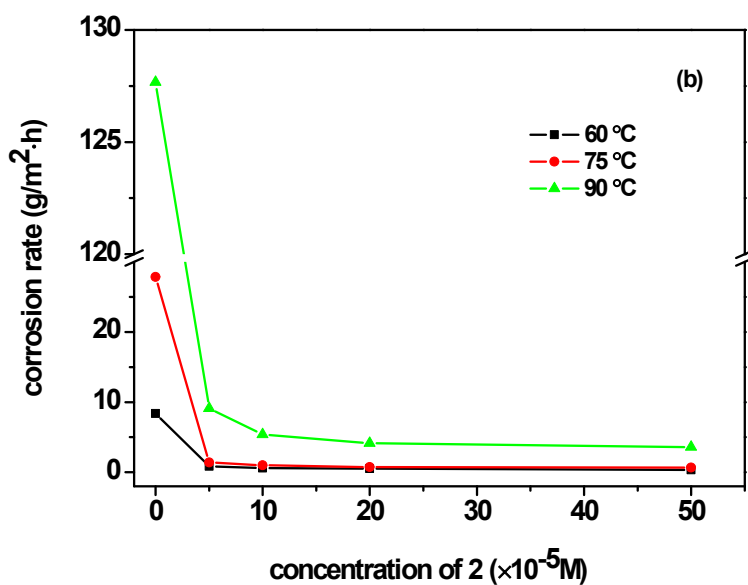
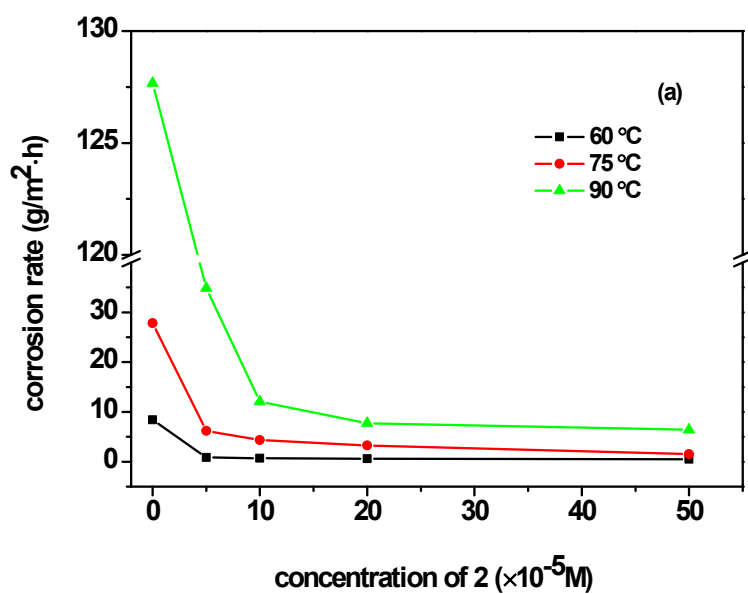
E-mail address: [hongyan-wang@snnu.edu.cn](mailto:hongyan-wang@snnu.edu.cn) (H. Y. Wang).

Received (in XXX, XXX) Xth XXXXXXXXXX 20XX, Accepted Xth XXXXXXXXXX 20XX

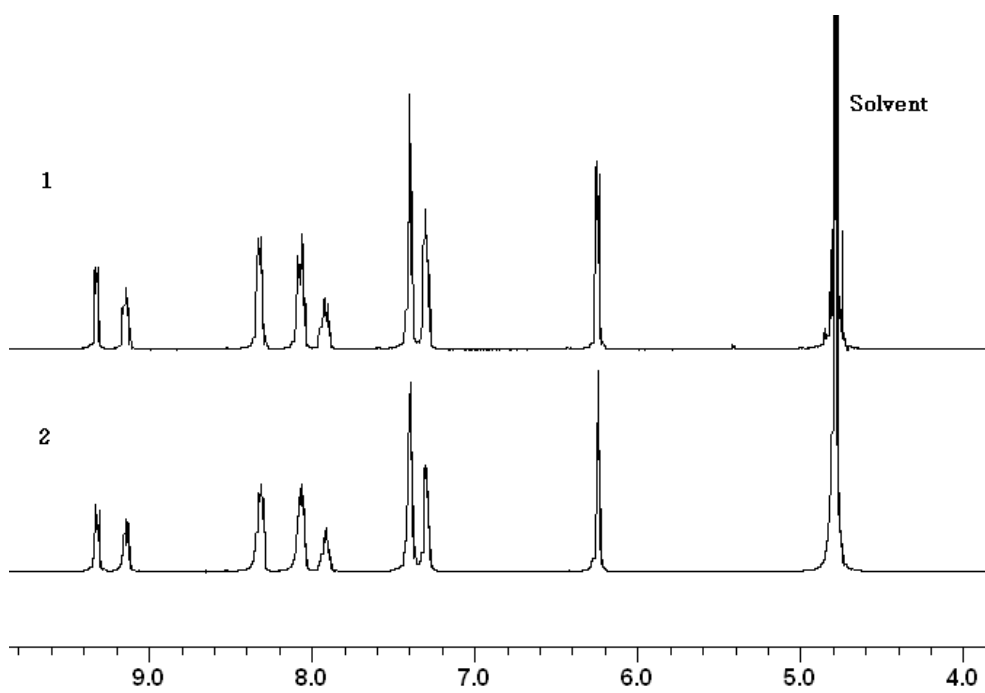
DOI: 10.1039/b000000x



**Fig. S1** Electrical equivalent circuit used for modeling metal/solution interface in the absence or presence of inhibitors **1** or **2** in 1.0 M HCl at 25 °C



**Fig. S2** Variation of corrosion rate for mild steel with different concentration of inhibitor **1(a)** and **2(b)** in 1.0 M HCl at 60 °C, 75 °C, and 90 °C respectively



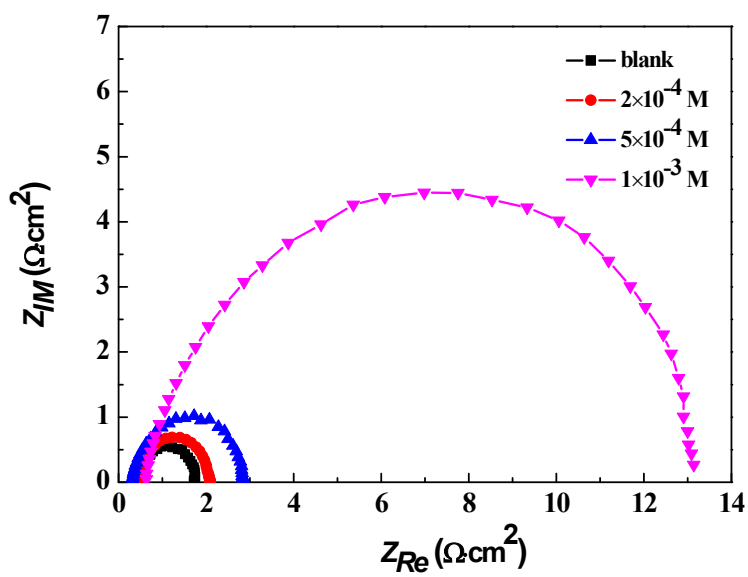
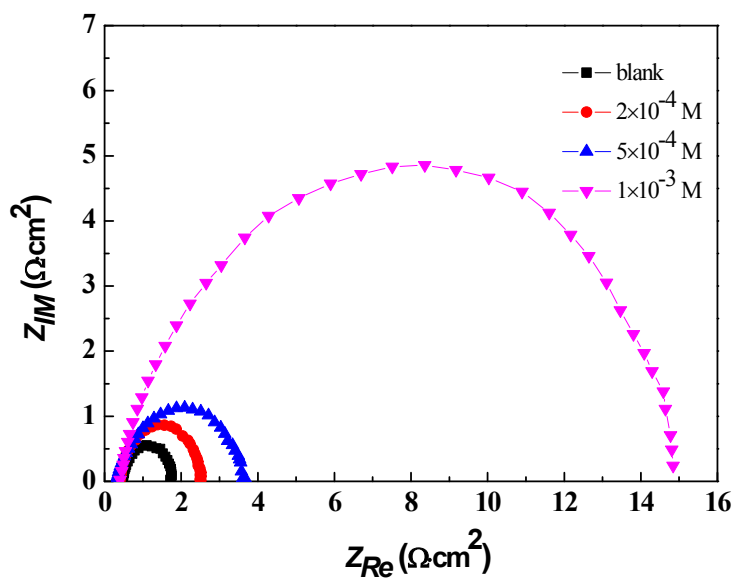
**Fig. S3** <sup>1</sup>H NMR spectrum of **1** and **2** in D<sub>2</sub>O respectively

**Table S1** Electrochemical parameters from Tafel polarization curves and inhibitionefficiency of **1** and **2** in 1.0 M HCl at 25 °C

<i>Inhibitor</i>	<i>Concentration,</i> M	$E_{corr}$ , mV	$I_{corr}$ , $\mu\text{A}\cdot\text{cm}^{-2}$	$\beta_a$ , mV	$\beta_c$ , mV	$\eta_p$ , %
<b>1</b>	0	-438.04	235.67	73.996	87.288	--
	$5.0\times 10^{-5}$	-423.72	26.24	66.668	117.05	88.87
	$1.0\times 10^{-4}$	-426.66	21.43	81.834	115.40	90.91
	$2.0\times 10^{-4}$	-425.27	16.25	94.496	118.71	93.11
	$1.0\times 10^{-3}$	-415.33	13.03	74.956	139.12	94.47
<b>2</b>	0	-438.04	235.67	73.996	87.288	--
	$5.0\times 10^{-5}$	-420.68	31.22	68.485	124.01	86.75
	$1.0\times 10^{-4}$	-423.56	25.94	75.002	107.61	88.99
	$2.0\times 10^{-4}$	-419.5	18.83	65.157	113.86	92.01
	$1.0\times 10^{-3}$	-412.01	14.97	64.112	122.11	93.65

**Table S2** EIS parameters for corrosion of mild steel containing differentconcentrations of **1** and **2** in 1.0 M HCl at 25 °C respectively

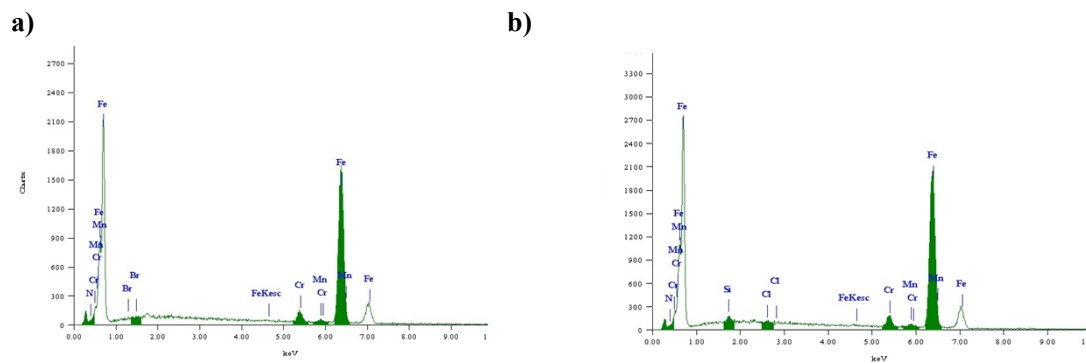
<i>Inhibitor</i>	<i>Concentration, M</i>	<i>R<sub>s</sub>, Ω·cm<sup>2</sup></i>	<i>C<sub>dl</sub>, μF/cm<sup>2</sup></i>	<i>R<sub>t</sub>, Ω·cm<sup>2</sup></i>	<i>η<sub>i</sub>, %</i>
<b>1</b>	0	1.99	139.7	236.8	0.00
	5.0×10 <sup>-5</sup>	2.168	90.612	655.9	63.90
	1.0×10 <sup>-4</sup>	2.021	80.31	730.7	67.59
	2.0×10 <sup>-4</sup>	2.164	83.99	858	72.4
	1.0×10 <sup>-3</sup>	2.134	73.29	1123	78.91
<b>2</b>	0	1.99	139.7	236.8	0.00
	5.0×10 <sup>-5</sup>	2.078	111.66	406.4	41.73
	1.0×10 <sup>-4</sup>	2.198	89.21	542.6	56.36
	2.0×10 <sup>-4</sup>	2.029	73.04	681.4	65.25
	1.0×10 <sup>-3</sup>	2.149	58.17	924.1	74.38



**Fig. S4** EIS behavior of mild steel containing different concentrations of **1** (a) and **2** (b) in 1.0 M HCl at 90 °C respectively

**Table S3** EIS parameters for corrosion of mild steel containing different concentrations of **1** and **2** in 1.0 M HCl at 90 °C respectively

<i>inhibitor</i>	<i>Concentration,</i> (10 <sup>-4</sup> M)	<i>R<sub>s</sub>, Ω·cm<sup>2</sup></i>	<i>C<sub>dl</sub>, μF/cm<sup>2</sup></i>	<i>R<sub>t</sub>, Ω·cm<sup>2</sup></i>	<i>η<sub>i</sub>, %</i>
<b>1</b>	0	0.47	0.94	1.29	0
	2.0×10 <sup>-4</sup>	0.49	0.91	1.58	18.35
	5.0×10 <sup>-4</sup>	0.31	0.87	2.46	47.56
	1.0×10 <sup>-3</sup>	0.58	0.80	12.61	89.77
<b>2</b>	0	0.47	0.94	1.29	0
	2.0×10 <sup>-4</sup>	0.40	0.89	2.12	39.15
	5.0×10 <sup>-4</sup>	0.31	0.79	3.32	61.14
	1.0×10 <sup>-3</sup>	0.39	0.71	14.03	90.81



	Element	(kev)	Mass (%)	Atom (%)
<b>1</b>	C	0.277	3.53	14.21
	N	0.392	0.76	2.64
	Br	1.480	0.10	0.06
	Fe	6.398	92.30	80.01
<b>2</b>	C	0.277	2.86	11.62
	N	0.392	1.03	3.60
	Cl	2.621	0.17	0.23
	Fe	6.398	91.97	80.39

**Fig. S5** the EDX spectrum of steel surface with:  $2.0 \times 10^{-4}$  M **1** (a) and **2** (b) after immersion at 90 °C for 4h