

Nicotinamide-based ionic liquid as a potential copper corrosion inhibitor

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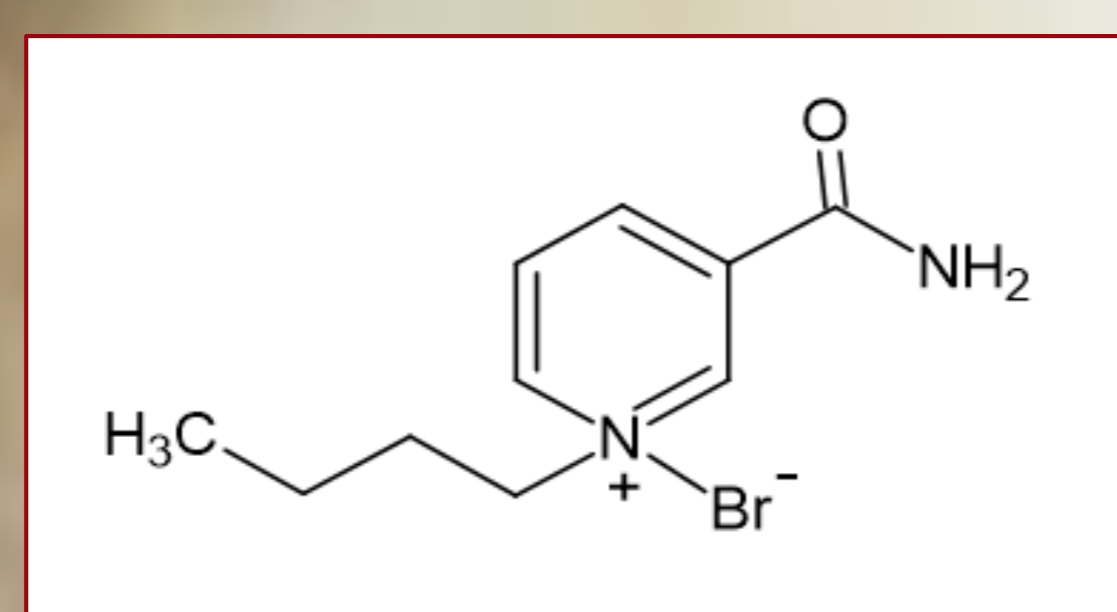
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ABSTRACT

Newly synthesized ionic liquid butyl-nicotinamide, $[C_4\text{Nic}]\text{Br}$ was investigated as a potential copper corrosion inhibitor, in acidic (pH=3) 0.1 mol/dm³ sodium-sulphate solution using a potentiostatic stationary voltammetry and electrochemical impedance spectroscopy.

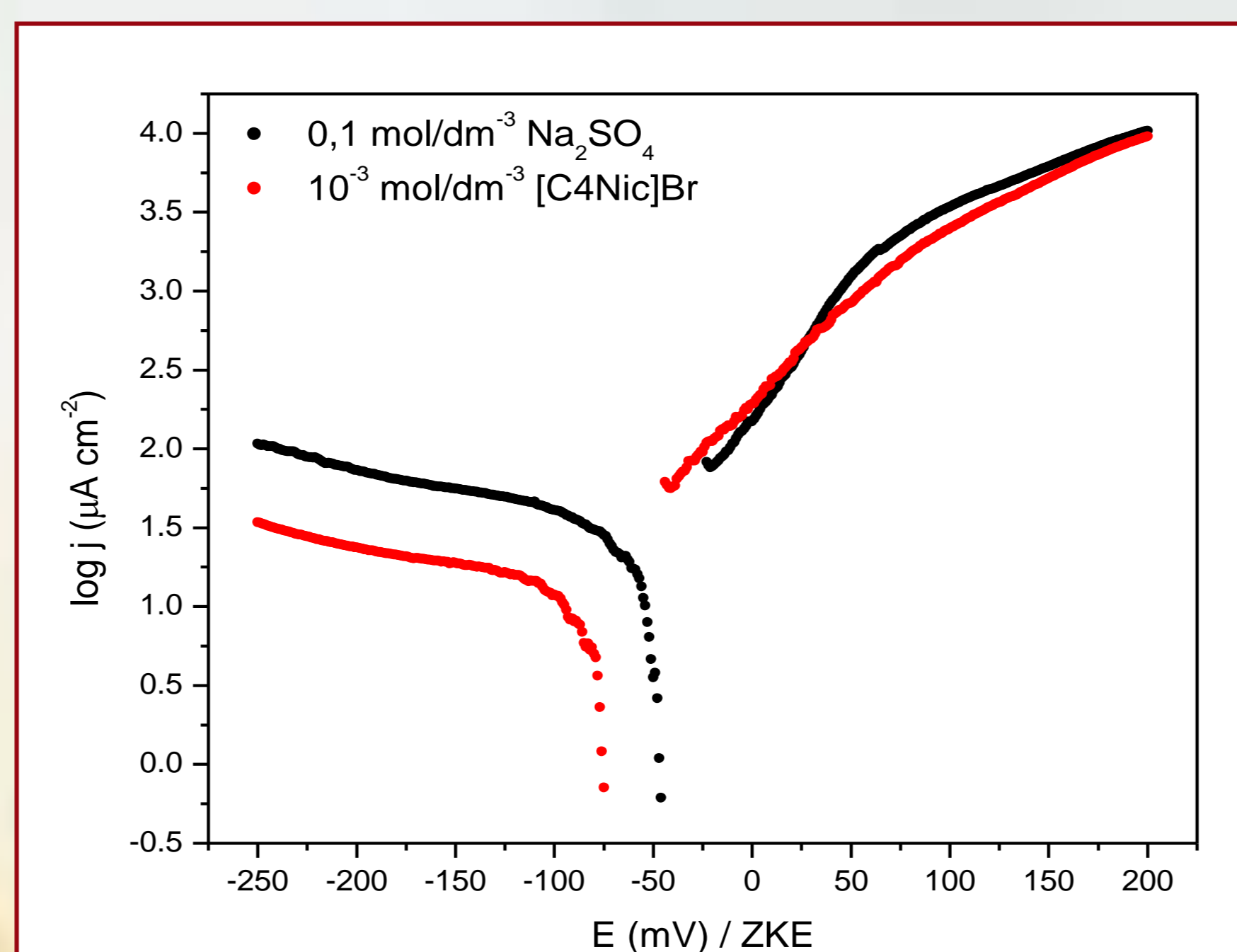
RESULTS OF POLARIZATION MEASUREMENTS

The obtained polarization curves of the copper electrode in 0.1 mol/dm³ Na₂SO₄ solutions with and without addition of $[C_4\text{Nic}]\text{Br}$ at 298K are shown in the Figure. The obtained corrosion current density, j_{corr} the corrosion potential, E_{corr} and inhibition efficiency, η , for different inhibitor concentration are presented in the Table. The protection is achieved by fast and spontaneous adsorption $[C_4\text{Nic}]\text{Br}$ on the copper surface following the Langmuir's adsorption isotherm, which was accompanied by a negative change in the free energy of adsorption, ΔG_{ads} .



Structure of the $[C_4\text{Nic}]\text{Br}$

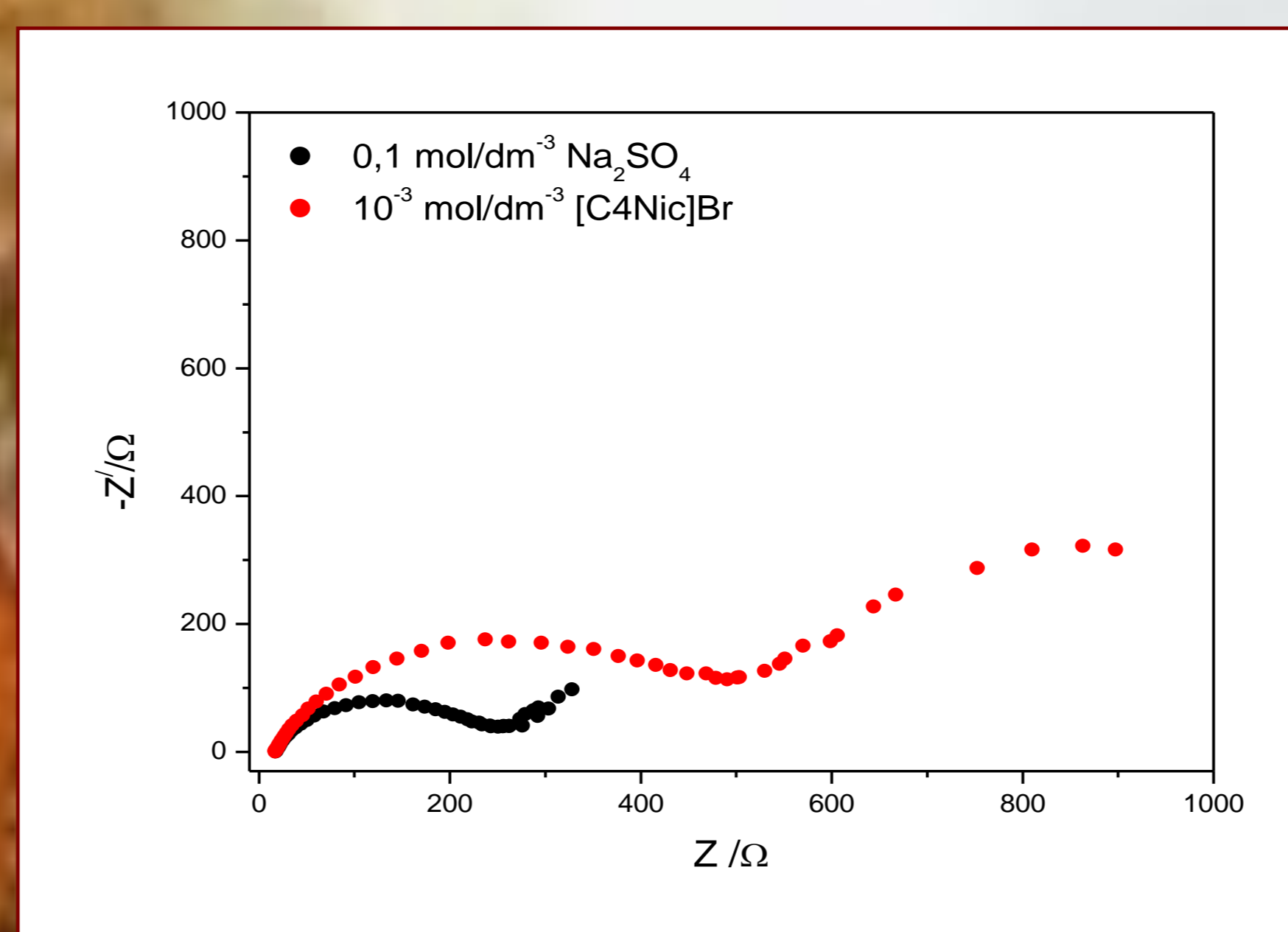
$\ln K$	$\Delta G_{\text{ads}} / \text{kJmol}^{-1}$	r
9.54	-33.6	0.999



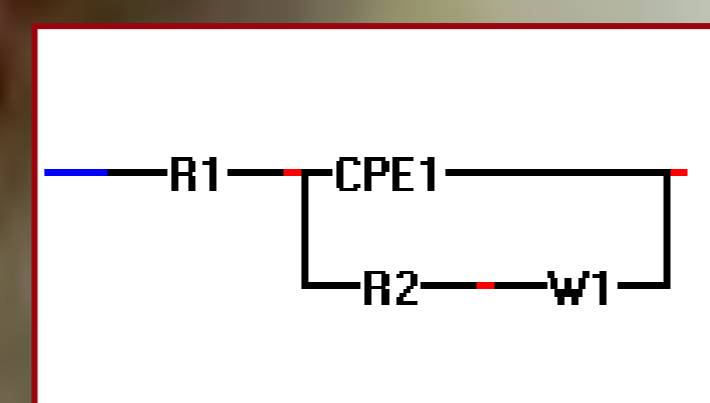
$c / \text{mol dm}^{-3}$	$E_{\text{corr}} / \text{mV}$	$j_{\text{corr}} / \mu\text{A cm}^{-2}$	$\eta / \%$
0.00	-23	32.03	-
$1 \cdot 10^{-5}$	-49	27.39	14
$5 \cdot 10^{-5}$	-44	23.15	28
$1 \cdot 10^{-4}$	-48	19.18	40
$5 \cdot 10^{-4}$	-44	16.03	50
$1 \cdot 10^{-3}$	-60	15.00	53

EIS RESULTS

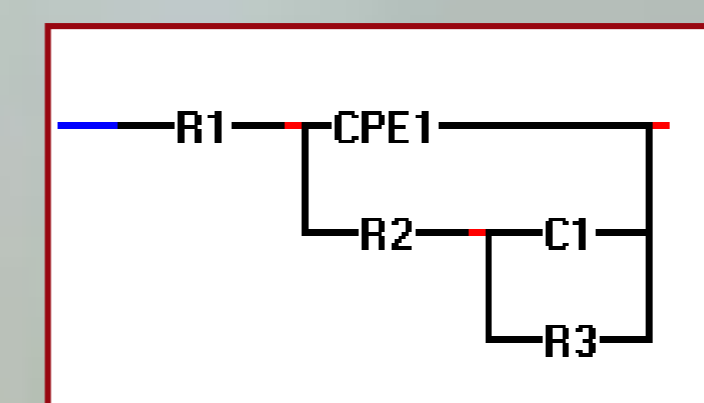
Figure depict the Nyquist plots for copper electrode in 0.1 mol/dm³ Na₂SO₄ and inhibitor solution. EIS results were fitted using the Eissa_0.1b program. Obtained models and the calculated EIS parameters and inhibition efficiency of $[C_4\text{Nic}]\text{Br}$ are presented.



c mol/dm ³	Z_w Ω	R_p Ω	Q_{ds} Fcm ⁻²	n	η %	R_{po} Ω	C_{po} Fcm ⁻²
0.00	9	215	$6.5 \cdot 10^{-2}$	0.80	-	-	-
$1 \cdot 10^{-5}$	-	420	$7.0 \cdot 10^{-3}$	0.70	49	300	2
$5 \cdot 10^{-5}$	-	530	$7.0 \cdot 10^{-3}$	0.71	59	320	2
$1 \cdot 10^{-4}$	-	560	$8.0 \cdot 10^{-3}$	0.70	62	330	2
$5 \cdot 10^{-4}$	-	620	$7.0 \cdot 10^{-3}$	0.70	65	330	3
$1 \cdot 10^{-3}$	-	780	$7.0 \cdot 10^{-4}$	0.70	72	330	6



Blank solution



Inhibitor solution

CONCLUSION

Obtained results confirmed that in acidic solution $[C_4\text{Nic}]\text{Br}$ has inhibitory properties against copper corrosion. Investigation compound inhibited a cathodic oxygen reduction reaction, whereby its effectiveness depends on the applied concentration. The effect of the investigated ionic liquid in copper protection is also manifest through the increase of the total resistance compared to the basic solution.