EVALUATION OF PROTECTIVE PROPERTIES OF AN INHIBITOR LAYER FORMED ON COPPER IN NEUTRAL CHLORIDE SOLUTION

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Different imidazole derivatives have proven to be effective as copper corrosion inhibitors in many corrosive media. Substitution by different functional groups can improve the efficiency of imidazole. Our previous investigations have shown that imidazoles containing phenyl ring show high inhibiting efficiency, much higher than the basic imidazole molecule. This effect is due to the electrondonating effect of phenyl ring, which increases electron density of the imidazole ring.

The aim of this work was to study protective property of film formed on copper surface in 3% NaCl solution containing 1-phenyl-4-methyl imidazole, by electrochemical methods (polarization resistance determination and cyclic voltammetry) as well as by atomic force microscopy (AFM).

Electrochemical measurements have shown that the investigated inhibitor significantly reduces copper corrosion rate in 3% NaCl solution. The polarization resistance of the protective layer is 20 times higher then that of the bare copper. It can be seen from cyclic voltammograms (Fig 1.) that the addition of the investigated inhibitor results in the shift of anodic peaks towards more positive values and lowers peak currents.

Topographical changes of copper surface were qualitatively characterized by AFM. The images were taken after 2-hour immersion. In noninhibited 3% NaCl solution, deep pits (ΔZ = 223 nm) were observed on the copper surface (Fig 2). A net of polymer-like depositions appeared on the surface of copper sample immersed in the inhibited solution, already in the very early period of immersion. Figure 3. presents the copper surface after 30 minutes of immersion in inhibited solution. The coverage of the metal surface increased in time significantly. After 2 hours, the entire metal surface was covered with a rough layer of precipitate that could keep the aggressive ions far from the metal surface.

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Solution	Rp (kΩ cm^2)	i_{corr} (μAcm^{-2})	z (%)
3% NaCl	1.98	9.92	-
+ Inh	39.16	0.88	91.13

Table 1. Parameters obtained by polarization resistance determination of copper in 3% NaCl solution and in solution containing 1-phenyl-4-methylimidazole

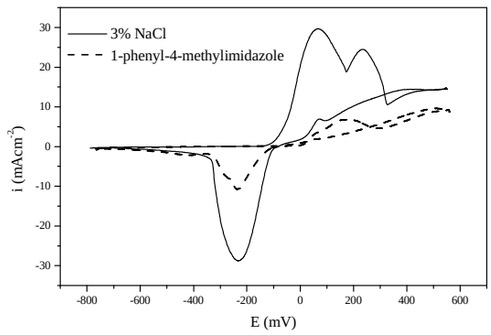

Figure 1. Cyclic voltammograms of copper in the absence and in the presence of investigated inhibitors

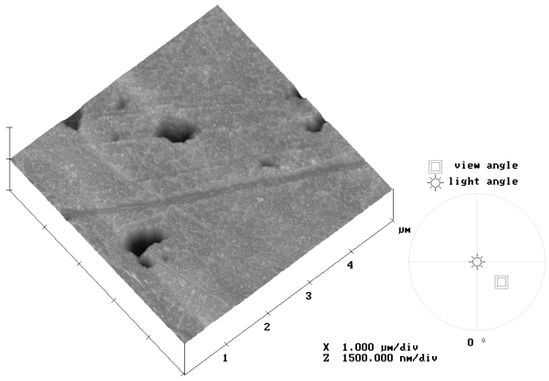

Figure 2. AFM image of copper surface after 2 h of immersion in 3% NaCl solution

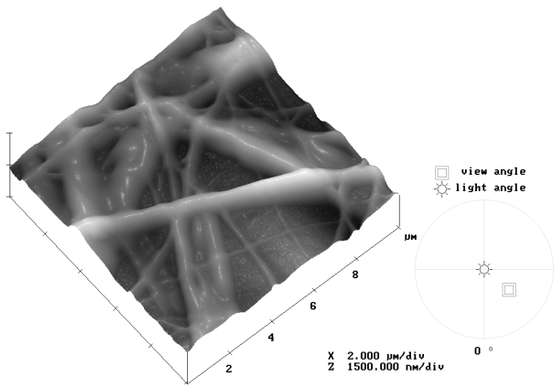

Figure 3. AFM image of copper surface after 30 min of immersion in 3% NaCl solution with addition of 5 mM 1-phenyl-4-methylimidazole