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Inhibition of copper corrosion in acidic sulphate media by eco-friendly amino acid compound

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This investigation aimed to study a "green" non-toxic biodegradable copper corrosion inhibitor in an acidic sodium sulphate solution. The methods used in the investigation of cysteine as a copper corrosion inhibitor in an acidic sodium sulphate solution were: potentiodynamic measurements, open circuit potential measurements, and chronoamperometric measurements. Optical microscopy was used in addition to electrochemical methods. Potentiodynamic measurements show that cysteine has good inhibitory properties in an acidic medium. Polarisation curves indicate that the presence of cysteine in a sulphate solution decreases the current density and that using various cysteine concentrations results in the formation of a protective film on the surface of the electrode due to the formation of the Cu(I)–cys complex. These results are confirmed by chronoamperometric measurements. Furthermore, it is clear from microphotographs that a protective film does form on copper electrode in the presence of cysteine. The Langmuir adsorption isotherm indicates that cysteine is chemisorbed on the surface of the electrode.

Keywords: copper, cysteine, polarisation, anodic dissolution, corrosion inhibition

Introduction

Copper has many industrial uses in everyday life due to its superior qualities. Despite its considerable resistance to various chemical reagents, it corrodes in certain media. In order to reduce dissolution of the metal, a wide range of corrosion inhibitors is used. Previous studies of copper corrosion have shown that, in alkaline solutions, passivation occurs on the metal surface as a result of the formation of copper oxide (Milošev et al., 2006).

Considerable attention has been directed towards investigation of chloride ions as the cause of corrosion of copper and its alloys (Antonijevic et al., 2005, 2009a; Milić & Antonijević, 2009). In order to prevent corrosion and avoid damage to the metal, a large number of potential corrosion inhibitors have been investigated. Good copper corrosion-inhibiting properties have been exhibited by organic compounds. Extraordinary results have been achieved using benzotriazole as an inhibitor of the corrosion of copper and its alloys (Frignani et al., 1999a, 1999b; Antonijevic et al., 2005, 2009b, 2009c). In addition to these organic compounds, good inhibiting properties were also exhibited by other organic molecules such as triazoles (Sherif et al., 2007), tetrazoles (El Issami et al., 2007; Szöcs et al., 2005), as well as organic heterocyclic compounds containing the mercapto group (Ye et al., 1998; Zucchi et al., 1996).

Sulphate ions were found to exert a stronger corrosion effect than chloride ions (Duthil et al., 1996; Souissi & Triki, 2008). One of the inhibitors used to prevent copper dissolution in 0.5 M Na_2SO_4 solution is bis-[4*H*-5-hydroxy-1,2,4-triazole-3-yl]methane (BHTAM) (El-Naggar, 2000). Many inhibitors have also shown a good inhibitory effect in acidic sulphate solutions (Benali et al., 2010; Gomma, 1998). However, azoles are toxic compounds and are considered

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