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Inhibiting effect of a synthesized organic compound, [3-(4-methoxyphenyl)isoxazole-5-yl]-methanol, on copper in 1 M sulfuric acid solution

Adibe Khezri[1], Ladan Ejlali[1], Moosa Eshaghi[*1], Mohammad Taghi Vardini[1], Hadi Basharnavaz[2]

[1]*Department of Chemistry, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
[2]*Department of Chemistry, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, Iran*

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ABSTRACT

[3-(4-Methoxyphenyl)isoxazole-5-yl]-methanol was synthesized and used as an efficient inhibitor to protect copper in 1 M sulfuric acid solution. Corrosion studies were performed by electrochemical techniques, including electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization (PDP), and quantum chemical calculations. The effect of temperature on the copper corrosion and inhibitor performance was also investigated. The data obtained from the analysis of the polarization curves disclosed that the corrosion current density (Icorr) of the metal dissolution decreased in the presence of inhibitor. This may indicate a reduction in the corrosion rate, resulting from the adsorption of inhibitor molecules on the active sites of the copper surface. Such a result was confirmed by the measured Nyquist diagrams, where total resistance increased with the addition of inhibitor to the medium. It was also found that the inhibitor adsorption on the copper surface obeyed from the Langmuir isotherm, and the adsorption process occurred both physically and chemically.

1. Introduction

Due to its high mechanical, electrical, and thermal features, copper is one of the most widely used metals in human life and various industrial fields. However, oxidation in the air causes a relatively dense oxide film, whose main components are CuO and $Cu(OH)_2$, on the copper surface. As a result, the thermal and electrical conductivities of copper may be adversely affected so that the applications of the copper products will be significantly limited. Accordingly, pickling as an efficient pretreatment is commonly used to remove the oxide film from the copper surface to reach a bright surface. This operation increases the possibility of corrosion for copper, making the use of metal corrosion inhibitors in the pickling bath necessary. Effective corrosion inhibitors are organic compounds because of having conjugated double bonds, heteroatoms, and polar functional groups, which can serve as active sites to adsorb on the metal surface [1–4].

However, many of such corrosion inhibitors are restricted in their applications because of serious problems that they impose on the environment. Accordingly, the environmental regulations proposed applying compounds that are not harmful to the environment to prevent the corrosion of industrial metallic facilities.

In recent years, many efforts have been made to explore low-toxic and non-toxic efficient corrosion inhibitors [5–9]. Within this framework, drugs or drug-like compounds have attracted much attention for use as inhibitors [10–13].

Components containing the isoxazole ring are an essential class of drugs, which could be an appropriate candidate for inhibition purposes. The O and N atoms existing on the isoxazole ring give the possibility of strong adsorption on the metal surface. On this basis, the present work aims to study the inhibiting effect of a synthesized isoxazole compound named [3-(4-methoxyphenyl)isoxazole-5-yl]-methanol on the copper corrosion in sulfuric acid solution.

2. Experimental

2.1. Synthesis of [3-(4-methoxyphenyl)isoxazole-5-yl]-methanol

In a 500 ml double-walled balloon, 11.75 mmol (87

∗ Corresponding author. e-mail: eshaghi.m@iaut.ac.ir