Abstract No: MO-20

Inhibition of aluminum corrosion using self-assembled layers of Zn(II) metal complex

Harindi W. A. and Weeraratne A. D. K. I.*

Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
isuriwe@sjp.ac.lk*

Metals naturally undergo corrosion, resulting in the formation of oxides that are more chemically stable. The most prevalent type of corrosion is caused by the electrochemical oxidation of metal through reaction with an oxidant such as hydrogen, oxygen, or hydroxide. Aluminum and its alloys are an important category of materials because of their great technological value and extensive industrial applications, particularly in the household and aircraft sectors. While aluminum's naturally occurring oxide layer protects it from corrosion in a variety of media, numerous studies have demonstrated that this layer can be damaged, and that metal can corrode when exposed to solutions containing chlorides in particular. Pitting corrosion is a common form of localized corrosion often observed in aluminum or aluminum alloys when exposed to chloride environments. Corrosion inhibitors are commonly used to minimize the harmful effects of corrosion. The main objective of this research project is to investigate the effectiveness of self-assembled layers of a redox innocent metal complex in inhibiting the pitting corrosion of aluminum. Here, a newly synthesized Schiff-base Zn(II) metal complex was studied as a corrosion inhibitor for aluminum substrates in chloride containing environments. The Schiff-base Zn(II) metal complex was synthesized by the reaction of Schiff base ligand (2,4-Di-tert-butyl-6-(4chlorophenyliminomethyl) phenol) and $ZnCl_2$ in hot methanol. The mixture was refluxed for 3 h, followed by cooling at room temperature. The pale-yellow color solid was filtered off and dried under vacuum. The yield was 70%. Synthesized Zn(II) metal complex was characterized using Thin Layer Chromatography (TLC), Fourier Transform Infrared (FTIR) spectroscopy, and UV-visible spectroscopy. The FTIR spectrum showed characterized peaks at 1582 cm^{-1} for C=N stretching vibration and 517 cm^{-1} for Zn-N starching vibration. The self-assembled layer technique was used to form films on the aluminum surface. The films were characterized using contact angle measurement, and they exhibited a contact angle of 108.038°, demonstrating good hydrophobicity. Finally, corrosion inhibition evaluation was done qualitatively and quantitatively using scanning electron microscope (SEM) images, and electrochemical impedance spectroscopy (EIS). SEM images showed that corrosion has inhibited in Zn(II) metal complex coated aluminum substrate than the bare aluminum substrate. In EIS the charge transfer resistance value (R_{ct}) indicates the resistance to the corrosion. Higher corrosion resistance is indicated by a higher R_{ct} value. Compared to the bare, unprotected substrate, aluminum substrate coated with Schiff base metal complex exhibited a noticeably higher R_{ct} value. SEM images and the Impedance measurements conformed that pitting corrosion in chloride containing medium of aluminum substrates can be inhibited by coating of Schiff base Zn(II) metal complex.

Keywords: Aluminum corrosion, Corrosion inhibition, Pitting corrosion, Schiff base metal complex, Self-assembled layer

Acknowledgment
This work was supported by Dr. A.D.K. Isuri Weeraratne under the research grant RG/2023/BS/01.