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Investigation of the effect of interlayer anion towards corrosion inhibition properties of Zn-Al layered double hydroxides

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Layered double hydroxides (LDHs) are layered materials showing tunable properties based on their composition. The structure provides interlayer spacing which can accommodate chemical species broadening its use for a number of applications. Corrosion is one of the prominent issues where various materials with corrosion inhibitory properties are still being developed for specific applications. Being a 2D material, LDH has potential to make an extended surface barrier and to utilize its interlayer space to trap corrosion inhibitors. In this study, we investigated the corrosion inhibition properties of Zn-Al LDH and its interlayer anion under corrosive conditions. Grade 304 stainless steel was selected as the substrate and aspartic acid which has the ability to exchange with Cl^- ions was used as the intercalated species. The corrosion inhibition properties were investigated using multi-technique approach including mass loss measurements, electrochemical impedance spectroscopy, and Tafel slope analysis. Results shows that the average mass loss of 7.8% under 2M HCl was decreased to 5.4% with Zn-Al LDH coating and it was further decreased to 5.1%, with aspartic acid intercalated LDH coating. The polarization resistance of bare SS Grade 304 which was 2.67 Ω was increased to 3.53 Ω with Zn-Al LDH coating and was further increased to 5.98 Ω with aspartic acid intercalated LDH coating. Together with Tafel polarization analysis, the corrosion inhibition efficiency of intercalated LDH showed 3.48% enhancement and 6.54% reduction of corrosion rate. Overall, the study reveals that the Zn-Al LDH exhibits corrosion inhibition properties by introducing physical barrier between the SS304 and the corrosive medium and the intercalated anion further enhances corrosion resistance through ion-exchange processes and suppression of Cl^- ion penetration.

Key words:

Zn-Al LDH, corrosion inhibition, aspartic acid intercalation, polarization resistance

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