Corrosion inhibition properties of cysteine for 201 stainless steel in acidic media

Siting Chen, Yushan Li, Jianbo Xu, Chaoyang Fu*

Key Laboratory of Material Chemistry for Energy Conversion and Storage, Ministry of Education, Hubei Key Laboratory of Materials Chemistry and Service Failure, School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, PR China.

M202270346@hust.edu.cn

Abstract: Stainless steel is one of the most widely used metal materials in today's industrial society. However, due to the recent increase in nickel prices, the industry has been prompted to start using low-nickel austenitic stainless steel. Therefore, the substitution of manganese for nickel stainless steel represented by 201 stainless steel (201 SS) has entered people's vision. In the present work, the corrosion inhibitor of 201 SS by cysteine in 1 M HCl is investigated. The corrosion inhibition performance of cysteine at 333 K is investigated by mass loss method and the results show that the corrosion inhibition efficiency of 96.56% is achieved at a concentration of 1.65 mM. The results of potentiodynamic polarization curves show that cysteine is a mixed inhibitor which mainly inhibits the cathodic reaction. It can be observed by SEM that the surface of the steel sheet added with cysteine is smoother than that of the blank, indicating that cysteine can effectively slow down the corrosion of the corrosion medium on the steel sheet. The adsorption of cysteine on the surface of 201 SS conforms to the Langmuir adsorption isothermal model, and the Gibbs free energy of adsorption is -23.45 kJ/mol, which indicating that the adsorption of cysteine on the surface of 201 SS is a mixed adsorption type of physical adsorption and chemical adsorption. The activation energy of the blank group is calculated as 44.19 kJ/mol by the Arrhenius equation, and the activation energy of the reaction increases to 78.66 kJ/mol at a cysteine concentration of 1.65 mM, indicating that the addition of cysteine to the corrosion medium inhibited the metal corrosion reaction. All the above results indicate that cysteine molecules can be effectively adsorbed on the surface of 201 SS and exhibit intentional corrosion inhibition properties.

Key words: 201 stainless steel; amino acid; corrosion inhibitor; adsorption