Experimental and Theoretical Studies of Cysteine and Melamine as Corrosion Inhibitors on Carbon Steel in Phase-Change-Materials Solution

Zhe Zhang¹, Weipeng Zhang¹, Wenwu Li¹, Xiaodong Huang¹, Le Ruan^{1,*}, Ling Wu²

¹ Guangxi Key Laboratory of Electrochemical and Magneto-chemical Functional Materials, College of Chemistry and Bioengineering, Guilin University of Technology, Guilin 541004, PR China.

² School of Chemistry and Chemical Engineering, Shandong University, Jinan 250100, PR China

*E-mail: ruanle@glut.edu.cn

doi: 10.20964/2019.02.52

Received: 12 September 2018 / Accepted: 19 November 2018 / Published: 5 January 2019

The corrosion protection performance of cysteine (Cys) and melamine (Mel) on 1045 carbon steel (CS) in a phase-change-material (PCM) solution has been studied by electrochemical impedance spectroscopy (EIS), potentiodynamic polarization (PDP) measurements, scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS). The EIS results showed that Cys and Mel can protect CS from corrosion in a PCM solution, and that a combined Cys/Mel inhibitor can increase the corrosion protection efficiency, achieving a value of up to 96.3%. The PDP measurements confirmed that Cys, Mel and combined Cys/Mel inhibitors can all protect CS from corrosion. The SEM micrographs showed that all three inhibitors can prevent the corrosion of CS in a PCM solution. The XPS results showed that Cys and Mel can adsorb onto the CS surface to form films, thereby inhibiting CS corrosion in PCM solutions. Quantum chemical calculations and molecular dynamics (MD) simulations were used to theoretically investigate the inhibition mechanism.

Keywords: Carbon steel; SEM; XPS; Quantum chemical calculation; Molecular dynamics simulation

[FULL TEXT](#)

© 2019 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).