

Preparation, controlled release, and anticorrosion behavior of benzotriazole-loaded modified halloysite nanotubes

Thanh Hai Pham^{1,2,3}, To Giang Tran^{2,3}, Nhi Tru Nguyen^{2,3}

¹Vietnam Institute for Tropical Technology and Environmental Protection, 57A Truong Quoc Dung Street, Phu Nhuan District, Ho Chi Minh City, Vietnam

²Ho Chi Minh City University of Technology, 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam.

³Vietnam National University Ho Chi Minh City, Linh Trung Ward, Ho Chi Minh City, Vietnam

Presenter's e-mail address: nguyennhitru@gmail.com

Abstract: Loading capacity and controlled release are two important features of smart corrosion inhibitor nanocontainers. In this presentation, we highlight recent findings of our group in modifying the surface of halloysite nanotubes (HNTs) and developing a tube end stopper to increase loading capacity and control benzotriazole (BTA) release. To increase BTA loading capacity, we employed a combination of two approaches: heat treatment and Zn²⁺ cation preadsorption, a method previously published by our team.[1] Besides, to control the release of BTA, two types of tube end stoppers have been investigated, including a complex between zinc ion and BTA (Zn-BTA) and a complex between ferric ion and tannic acid (Fe-TA). The results showed that surface treatment and modification increased the BTA loading capacity of modified HNT to 15.5 wt.%, much higher than the 4.57 wt.% of the original HNT. Moreover, the BTA release process was also controlled by either the Zn-BTA or Fe-TA stoppers. Both stoppers exhibited slow BTA release rates from the nanocontainers in neutral environments and gradually increased as pH decreased. As a result, the smart corrosion inhibitor nanocontainer systems Zn-BTA@BTA/modified-HNT and Fe-TA@modified-HNT not only show excellent corrosion inhibition effects but also exhibit active corrosion inhibition properties when applied as additives in epoxy coatings on carbon steel, as demonstrated by electrochemical measurements and salt spray testing.

Keywords: halloysite nanotubes, benzotriazole, corrosion inhibition, controlled release

Reference

[1] Pham, T. H., Nguyen, T. C., Le, A. K., Le, P. K., & Son, D. N. (2022). Insights into effects of metal cations on the adsorption of Benzotriazole on halloysite nanotubes: an experimental and DFT study. *The Journal of Physical Chemistry C*, 126(5), 2920-2929.