Effects of Grain Size on the Corrosion Inhibition and Adsorption Performance of Benzotriazole on carbon steel in NaCl Solution

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Abstract Corrosion inflicts significant financial burdens and poses substantial risks to both safety and the environment [1]. Among the various methods available for corrosion prevention, organic corrosion inhibitors have demonstrated notable effectiveness in safeguarding metallic materials [2-3]. This study investigates the adsorption mechanism, the process of film formation, and the corrosion inhibition performance of benzotriazole on carbon steels with different grain sizes (i.e., 24.5 μm, 4.3 μm, and 0.6 μm) in 3.5 wt.% NaCl solution. An ultrafine grain of 0.6 μm exerts a favorable influence on facilitating the creation of a stable and compact corrosion inhibitor film, which resulted in enhanced corrosion resistance and suppressed localized corrosion. These advantageous effects can be attributed to the higher adsorption energy at grain boundaries in contrast to grain interiors, expediting the physisorption process and promoting the chemisorption of organic corrosion inhibitors. The investigation comprehensively illustrates, for the first time, the effects of grain size on the adsorption mechanism, film formation process, and inhibition performance of organic corrosion inhibitors on carbon steels. This study demonstrates a promising approach to enhancing corrosion inhibition performance through microstructural design.

Keywords Carbon steel; Corrosion inhibitor; Grain refinement; Microstructure; Adsorption mechanism

Reference

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