Study on hydrogen permeation and stress corrosion cracking behaviors of AISI 4135 high-strength steel with macrofouling adhesion in marine immersion zone

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Abstract Macrofouling adhesion can increase the hydrogen permeation and SCC sensitivity of high-strength steels, but related research needs to be refined. A field exposure test was set up to study the effect of macrofouling adhesion on hydrogen permeation and stress corrosion cracking (SCC) behaviors of a high-strength steel in marine immersion zone, and the results were further verified by laboratory electrochemical simulation tests.

The results indicated that the crevices formed by macrofouling adhesion (**Fig. 1**) can promote localized corrosion pits and change the local chemical environment on the surface of high-strength steel under natural corrosion and cathodic protection state. More severe localized corrosion can increase the hydrogen permeation current density and promote the SCC of high-strength steel under natural corrosion state. As a comparison, the hydrogen permeation current density of steel under cathodic protection state was slightly decreased owing to the shielding effect of macrofouling. Meanwhile, the macrofouling increases the SCC sensitivity of high-strength steel under cathodic protection state by promoting localized corrosion.

Keywords High-strength steel; Macrofouling adhesion; Crevices; Hydrogen permeation; Stress corrosion cracking

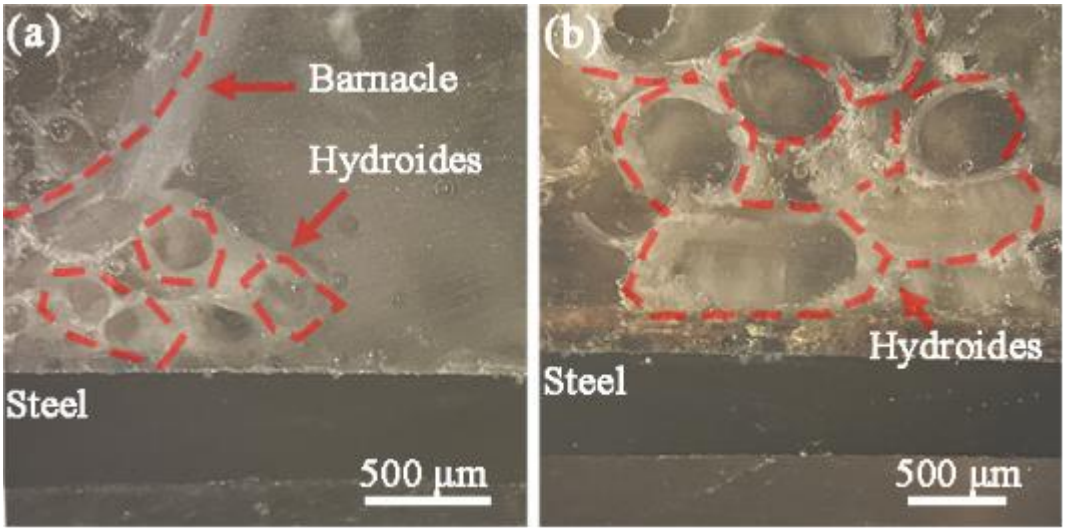

Fig. 1 The cross-sectional photos of sensors with macrofouling adhesion.