The Relationship between Hydrogen Diffusion Parameters and Hydrogen Assisted Cracking Susceptibility in High Strength Steel under Tensile Stress

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Hydrogen assisted cracking (HAC) failures have been one of the major technical issues for development of high-strength steels used in sour environment, since H_2S gas facilitates the diffusion of hydrogen atoms into the steels. Diffused hydrogen atoms are reversibly or irreversibly trapped at various metallurgical defects in the steel, resulting in the cracking failures. Although the role of reversible and irreversible trapping sites for hydrogen atoms in the HAC has been widely discussed and reported in various literature, the relationship among the applied tensile stress, hydrogen trapping behavior and the cracking phenomenon has not been fully clarified. The recent investigations have suggested that the application of tensile stress can change the irreversibly trapped hydrogen contents as well as diffusible hydrogen contents in the steel, leading to more susceptible to the HAC.

In the present study, the influence of applied tensile stress on reversible and irreversible trapping phenomena of hydrogen atoms and the susceptibility to HAC will be investigated by utilizing the electrochemical permeation technique. Particularly, in order to accurately measure the irreversibly trapped hydrogen contents in the steel under loading condition, the stepwise sequence involving '1^{st} permeation-desorption-2^{nd} permeation under loading condition' will be employed in the permeation test.