Effect of nitrogen on the hydrogen-assisted cracking behavior in the novel multiphase stainless steel

Menghao Liu[1, 2], Cuiwei Du[1, 2*], Xiaogang Li[1,2]

[1] *Beijing Advanced Innovation Center for Materials Genome Engineering, Institute for Advanced Materials and Technology, University of Science and Technology Beijing, Beijing 100083, China*

[2] *National Materials Corrosion and Protection Data Center, University of Science and Technology Beijing, Beijing 100083, China*

Abstract Multiphase stainless steel is a novel stainless steel with good mechanical properties, owing to the transformation-induced plasticity (TRIP) effect of retained austenite. We explored the influence of nitrogen alloying on the resistance to hydrogen-assisted cracking of a novel multiphase stainless steel, aiming to develop a multiphase stainless steel resistant to hydrogen embrittlement. This was accomplished through techniques such as transmission electron microscopy (TEM), electron backscatter diffraction (EBSD), slow strain rate tensile testing (SSRT), and thermal desorption spectroscopy methods (TDS).

The results showed that nitrogen alloying decreased the susceptibility of multiphase stainless steel to hydrogen-assisted cracking, resulting in an 8% reduction under the in-situ hydrogen charging condition and a 30% reduction under the pre-hydrogen charging condition. Nitrogen alloying increased the austenite content in multiphase stainless steel, decreased the apparent diffusion coefficient of hydrogen in multiphase stainless steel, and inhibited the diffusion of hydrogen within the material. Additionally, nitrogen alloying enhanced the stability of austenite in multiphase stainless steel, thus delaying the initiation of hydrogen-assisted cracks.

Corresponding author: Cuiwei Du, professor at University of Science and Technology Beijing. Her research directions include corrosion in soil environment and microbiologically influenced corrosion.
Contact information: 30 Xueyuan Road, Haidian District, Beijing 100083, China, email address: dcw@ustb.edu.cn.

Keywords Multiphase stainless steel; Hydrogen-assisted cracking; Hydrogen embrittlement