Microstructural origins of enhanced resistance to H-assisted fatigue crack growth in ausformed and tempered martensitic steels

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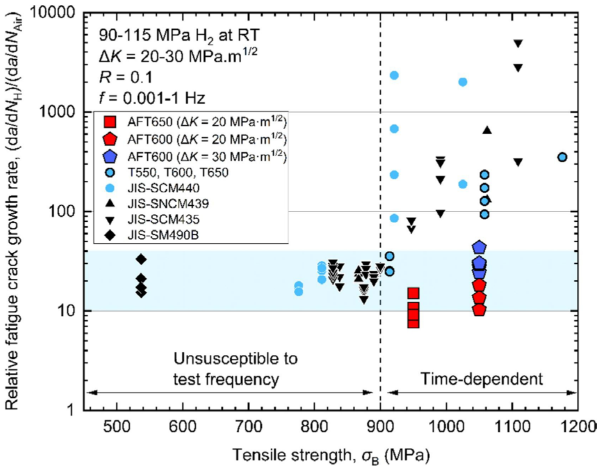
Lean-alloyed martensitic steels are promising, cost-effective materials for the storage and transportation of hydrogen gas. Previous studies [1] showed that martensitic steels with tensile strength (TS) below 900 MPa exhibited cycle-dependent H-assisted fatigue crack growth (HAFCG), while those above 900 MPa showed time-dependent (or frequency-dependent) HAFCG-undesirable for fatigue life design [1] (Fig. 1). Recently, Redarce et al. [2] developed an ausformed and tempered martensitic (AFT) steel with a TS of 1050 MPa that displayed cycle-dependent HAFCG (Fig. 1). In the presented study, we quantify the microstructural crack paths of HAFCG in AFT steel and compare them with their tempered counterparts. Detailed characterization was performed using electron backscatter diffraction, transmission Kikuchi diffraction, and transmission electron microscopy to understand the microstructural origins of enhanced resistance to HAFCG in ausformed and tempered martensitic steels. H-permeation studies were performed to study the H diffusion behavior of the tempered and AFT steels.

The hydrogen embrittlement (HE) symposium spanned all five days of the conference. It provided a great opportunity to interact with researchers from both academia and industry, from across the globe, working on HE. I gained valuable insights into HAFCG in a hydrogen atmosphere & the micro-mechanisms of HE. Conversations with experts in martensitic steels were helpful in deepening my understanding of HAFCG in ausformed steels.

Fig. 1: The relationship between the relative FCG rate and tensile strength (from Redarce et al. [2] (CC BY 4.0))



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