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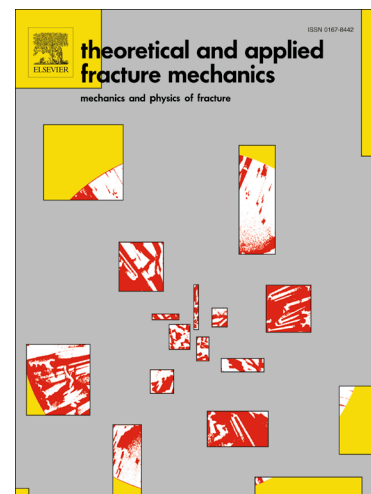
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Hydrogen Embrittlement and Micro-Damage in Notched Specimens of Progressively Cold-Drawn Pearlitic Steel Wires

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ABSTRACT

Cold-drawn pearlitic steel wires are highly susceptible to hydrogen assisted fracture (HAF) related phenomena in the presence of hydrogenating environments. A widely spread test method for estimating such a phenomenon is the constant extension rate tensile (CERT) test using notched samples under cathodic electrochemical conditions. In this paper, a global study of the fracture process of progressively cold-drawn wires subjected to CERT testing is carried out by analysing diverse parameters: (i) *triaxiality* in terms of the samples notch geometry, varying the parameters that define a circumferentially round notched wire (notch radius and notch depth); (ii) the CERT test *loading rate*; (iii) the level of *microstructural damage and anisotropy* caused during a commercial cold drawing. The obtained results allow one to determining the influence of each factor on the HAF of cold-drawn pearlitic steel wires and, in addition, defining four micromechanical models in terms of diverse *micro fracture maps* representing the fracture events.

KEYWORDS:

Cold-drawn pearlitic steel, notch, stress triaxiality, hydrogen embrittlement, hydrogen-assisted micro-damage, tearing topography surface.

NOMENCLATURE

A: Notch depth

C: Cleavage

CERT: Constant extension rate tensile

d_i : Diameter of the steel obtained after the i -th step of cold drawing

ϵ_P^i : Cumulative plastic strain of the steel obtained after the i -th step of cold drawing

FPZ: Fracture process zone

HAMD: Hydrogen-assisted micro-damage

HAF: Hydrogen assisted fracture

HDT: Hydrogen damage topography

HE: Hydrogen embrittlement

L: Longitudinal

LAD: Localized anodic dissolution

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