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INVESTIGATION OF HYDROGEN DAMAGE EFFECTS ON 22MNB5 MARTENSITIC STEELS USING ION IMPLANTATION

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Resumo:
Hydrogen embrittlement (HE) is a particularly difficult phenomenon to investigate since it involves aspects that range from physical metallurgy to electrochemistry and fracture mechanics. Its importance in technology is, however, overwhelming, since HE can lead to severe failures in service, in catastrophic situations, particularly in the case of martensitic steels. The control and prevention of these failures require investigating the basic HE mechanisms that lead to crack nucleation and growth, sometimes with contradicting effects. In this sense, a major milestone was a unified HELP+HEDE model proposed by Djukic et al. [1,2] to describe the synergy of HE mechanisms in ferritic and other steels. The present work aims to investigate the applicability of this model to understand HE embrittlement in press hardening steels. These martensitic steels are quenched after hot forming in the press matrix, with Boron added in small

amounts to achieve sufficient hardenability. One of the most used steels of this class is the DIN 22MnB5 steel. There is evidence that the HELP+HEDE model could be applied to this class of steels [2]. The methodology is adapted from previous works by one of the present authors [3] and involves localized implantation of hydrogen in the matrix of the steel, with the posterior investigation of the structure using Transmission Electron Microscopy (TEM). As a result, it is expected to identify the early-stage HE damage produced in the hydrogen rich layer of the material, as a function of the implanted dose and energy. [1] M. B. Djukic, V. Sijacki Zeravcic, G. M. Bakic, A. Sedmak, B. Rajicic. Hydrogen damage of steels: A case study and hydrogen embrittlement model. Engineering Failure Analysis. 2015; 58:485–498. [2] M. B. Djukic, G. M. Bakic, V. Sijacki Zeravcic, A. Sedmak, B. Rajicic. The synergistic action and in - terplay of hydrogen embrittlement mechanisms in steels and iron: Localized plasticity and decohesion. Engineering Fracture Mechanics 2019; 216:106528. [3] S. Reboh, M. F. Beaufort, J. F. Barbot, J. Grilhé, P. F. P. Fichtner. Orientation of H platelets under lo - cal stress in Si. Appl. Phys. Letters 2008; 93: 022106.