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Hydrogen effect on the deformation evolution process in situ detected by nanoindentation continuous stiffness measurement

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Abstract

Nanoindentation continuous stiffness measurement has been used to study the hydrogen effect on deformation in stable 310S and metastable 304 stainless steels at room temperature. Both stainless steels are gaseous hydrogen-charged. It is first found that the extent of hydrogen effect on the mechanical property is dependent on the deformation stage. Hydrogen decreases the elastic modulus and increases the hardness in the initial stage of plastic deformation, while the hydrogen effect becomes weaker and remains nearly constant with further plastic deformation, attributing to the evolution from mobile dislocation to immobile dislocation. α′ martensite increases the elastic modulus and hardness. α′ martensite counteracts the hydrogen effect on elastic modulus, while the superposition of hydrogen and α′ martensite increases the measured hardness

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