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PREDICTION OF HOLE-EXPANSION FORMABILITY OF MULTI-PHASE STEELS USING 3D MICROSTRUCTURE-BASED MODELING

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Ferrite-bainite (FB) steels have better hole expansion formability than martensite-ferrite dual-phase (DP) steels, even though both steels have similar tensile strengths and similar microstructures with soft and hard phases. Previously, the hole expansion formability of DP steels was analyzed using the realistic microstructure-based models constructed using mesh generation process with a boundary-smoothing algorithm [1,2]. In this work, 3D microstructure-based FE simulations were carried out in order to analyze the difference in hole expansion formability between the FB and DP steels. The 3D images of the two steels were obtained from the serial sectioned-2D micrographs. Then, the 3D images were converted into the realistic micromechanical models. The developed models were applied to investigate the effect of microstructure on the hole-expansion formability. In particular, the difference of hole-expansion formability between DP and FB steels was explained in the microstructural viewpoint. The effect of anisotropic hardening of the constituent phases on the formability was also investigated using the Homogeneous yield function-based Anisotropic Hardening (HAH) model.

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