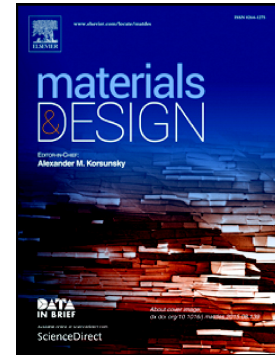


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Low temperature superplastic-like deformation and fracture behavior of nano/ultrafine-grained metastable austenitic stainless steel

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Abstract

We describe here the low temperature superplastic-like deformation in a nano/ultrafine-grained metastable austenitic stainless steel tensile tested at a strain rate of $2.5 \times 10^{-4} \text{ s}^{-1}$ and temperature of 600°C (~0.43 of the absolute melting point). The nano/ultrafine-grained structure was obtained via a combination of cold rolling (~93% in reduction), followed by reversion annealing treatments at 650°C for 10 min, 30 min, and 700°C for 2 min, 5 min, respectively, an approach previously adopted by Misra's group (references 11-16). The reversion of martensite to austenite was dominated by diffusional mechanism. The nano/ultrafine-grained steel exhibited superplastic-like behavior with maximum elongation approaching ~153% and strain rate sensitivity of ~0.22. Furthermore, tensile deformation behavior at 20°C and 600°C, and the corresponding fracture characteristics are discussed. Observations of fracture surface indicated that the fracture was characterized by line-up of voids along the striations, when tensile tested at 20°C. Whereas, the fracture surface at 600°C mainly consisted of uniform distribution of dimples. To further study the fracture mechanism during superplastic-like deformation, deformed structures from the longitudinal region close to the tip of the fracture surface were studied. The fracture surface of superplastic-like deformed steel was characterized by interlinkage of cavities.

Keywords: Austenitic stainless steel; Nano/ultrafine-grained structure; Reversion mechanism; Superplasticity; Fracture

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