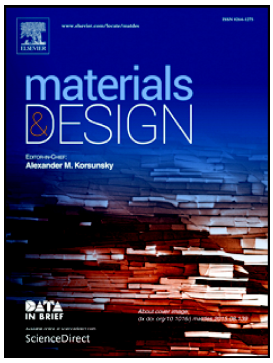
Accepted Manuscript




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

G.S. Sun, L.X. Du, J. Hu, H. Xie, R.D.K. Misra

PII: S0264-1275(16)31613-6
DOI: doi: 10.1016/j.matdes.2016.12.086
Reference: JMADE 2631

To appear in: *Materials & Design*

Received date: 19 October 2016
Revised date: 23 December 2016
Accepted date: 27 December 2016

Please cite this article as: G.S. Sun, L.X. Du, J. Hu, H. Xie, R.D.K. Misra , Low temperature superplastic-like deformation and fracture behavior of nano/ultrafine-grained metastable austenitic stainless steel. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2016), doi: 10.1016/j.matdes.2016.12.086

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

G.S. Sun[a], L.X. Du[a,*], J. Hu[a], H. Xie[a], R.D.K. Misra[b]

[a] The State Key Laboratory of Rolling and Automation Northeastern University, Shenyang 110819, China

[b] Laboratory for Excellence in Advanced Steel Research, Department of Metallurgical, Materials and Biomedical Engineering, University of Texas at El Paso, 500W. University Avenue, E1 Paso, TX 79968, USA.

## Abstract

We describe here the low temperature superplastic-like deformation in a nano/ultrafine-grained metasable austenitic stainless steel tensile tested at a strain rate of $2.5\times10^{-4}$ $s^{-1}$ 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

Corresponding author: L.X. Du, Tel.: +86 24 83683603, Fax: +86 24 23906472, E-mail address: dulx@ral.neu.edu.cn.