ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

Discontinuous deformation of FCC high entropy alloys at temperatures close to 0 K

A. S. Tirunilai[a], T. Hanemann[a], K.-P. Weiss[a], J. Freudenberger[b], C. Reinhart[c], G. Laplanche[c], M. Heilmaier[a], A. Kauffmann[a]

[a] *Karlsruhe Institute of Technology (KIT),*

[b] *Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden) and TU BA Freiberg,*

[c] *Institute for Metals, Ruhr-University Bochum (RUB)*

aditya.tirunilai@kit.edu

The FCC multicomponent alloys CoCrFeMnNi and CoCrNi have shown significant improvements in strength and ductility at 77 K [1, 2]. The present work investigates the deformation of these alloys at temperatures close to 0 K. The results are analyzed to identify the active deformation mechanisms and their contribution to strain hardening at different cryogenic temperatures. The deformation mechanisms are identified through SEM and TEM analysis and are correlated to strain-hardening trends determined from the engineering stress-strain curves. The results show clear indication that deformation twinning is a dominant contributor to strain-hardening. This is despite the expected effect of HCP martensite in CoCrNi [3]. Additionally, contrary to the prediction [4], no HCP martensite is observed during deformation at 4 K in CoCrFeMnNi. At very low temperatures, the alloys also show discontinuous deformation with stress drops in excess of 10% of yield strength. The discontinuous deformation is not affected by heat dissipation, activation of deformation twinning or HCP martensite formation. The present research thus (i) identifies deformation behavior in CoCrFeMnNi and CoNiCr at temperatures close to 0 K; (ii) identifies their contribution to strength and (iii) characterizes discontinuous deformation at close to 0 K.

Keywords: cryogenic deformation, deformation twinning, martensite formation, serrations

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