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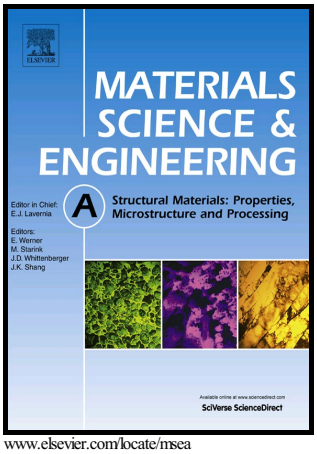

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Deformation mechanisms of $Al_{0.1}CoCrFeNi$ high entropy alloy at ambient and cryogenic temperatures

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Highlights

- *Lowering the temperature to 77 K can lead to an extensive* strain-hardening *ability in $Al_{0.1}CoCrFeNi$ HEA.*
- *The serrations phenomena are observed, which is associated with the nano-twinnings substructure.*
- *The present investigation gives a sight to reveal the deformation mechanisms of $Al_{0.1}CoCrFeNi$ HEA at different temperatures.*

Abstract

The deformation mechanisms of an $Al_{0.1}CoCrFeNi$ high entropy alloy (HEA) produced by the vacuum levitation melting (VLM) method were studied in the compression test at temperatures range from 298 K to 77 K. The nominal yield strength was 120, 168, 275 MPa for the alloy tested at 298, 200, and 77 K, respectively. Note that all the compression tests were done only up to the ~ 50% plastic strains. In addition, the remarkable strain-hardening ability and the serration phenomena were observed during the deformation of the alloy at 77 K. Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) characterizations revealed that at 298 and 200 K, the deformation in the alloy occurs on the normal FCC {111}<110> slip systems by planar dislocation glide. In contrast, at 77 K, nano-twinning becomes an additional deformation mechanism. Overall, the significant increase in the nominal yield strength, extensive strain-hardening ability, and the serration phenomena are attributed to the capability of extensive nano-twinnings at 77 K.