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Strength–ductility balance in an ultrafine-grained non-equiatomic $Fe_{50}(CoCrMnNi)_{50}$ medium-entropy alloy with a fully recrystallized microstructure

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Highlights

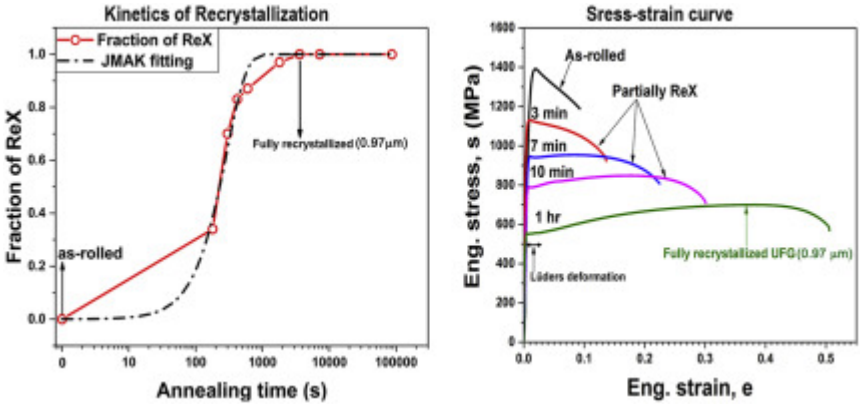
- Phase stability of $Fe_{50}(CoCrMnNi)_{50}$ medium-entropy alloy investigated.
- Excellent combination of strength and ductility of ultrafine-grained structure.
- Lüders elongation was shortened with increasing discontinuous yield stress.
- Materials were characterized for economic feasibility in industrial applications.

Abstract

We explored the phase stability and mechanical properties of an ultrafine-grained non-equiatomic $Fe_{50}(CoCrMnNi)_{50}$ medium-entropy alloy (MEA). The alloy was processed by conventional cold rolling and then annealed at temperatures between 500 °C and 800 °C. X-ray diffraction revealed that this alloy has a single face-centered cubic structure even below 800 °C, where the equiatomic CoCrFeMnNi mostly forms second phases. The kinetics of recrystallization

0.97 μm is achieved after annealing at 600 °C. Tensile results further revealed that this alloy overcomes the strength–ductility trade-off experienced in nanocrystalline alloys, showing an excellent combination of strength and ductility. The origin of discontinuous yielding behavior in both partially recrystallized and fully recrystallized ultrafine-grained specimens is discussed.

Graphical abstract



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Keywords

Metal and alloys; X-ray diffraction; Crystal structure; Microstructure; Mechanical properties; Entropy

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[1] MC and IO equally contributed to this work.

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