MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF Al-DOPED CoCrFeMnNi WITH DUAL-PHASE FCC/B2 STRUCTURE

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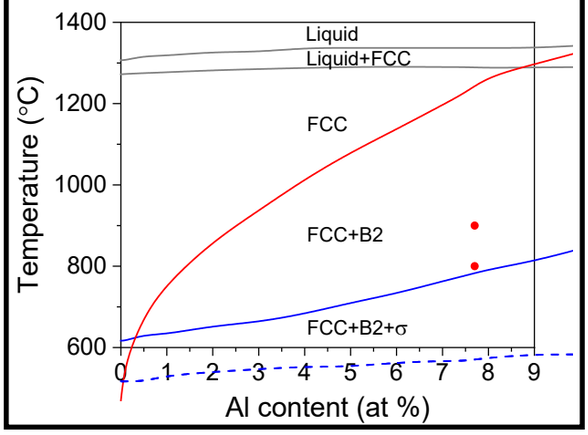
Abstract

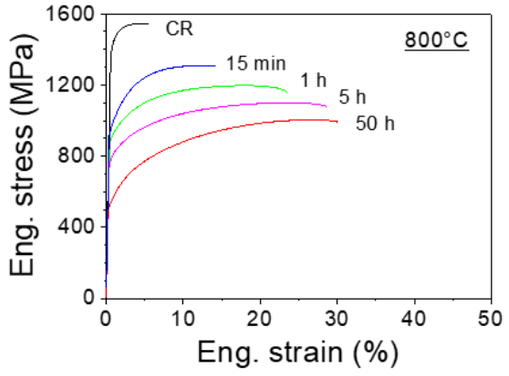
High entropy alloys (HEAs) based on the well-known Cantor CoCrFeMnNi alloy are known for their exceptional ductility and damage tolerance, especially in cryogenic conditions. However, the strength of these alloys with a single face-centered cubic (fcc) phase is often insufficient for practical application. More balanced properties can be obtained when additional hard phases are added. For example, alloying with Al can result in the precipitation of a hard B2 phase particles in the soft fcc matrix. However, proper tailoring of the microstructure and mechanical properties require careful control over chemical composition and processing condition.

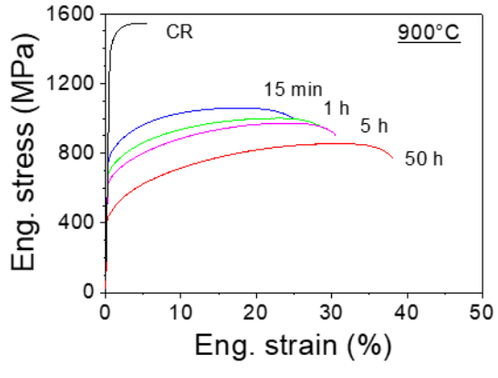
In the present work, the CoCrFeMnNi-type doped with ~8 at.% of Al was studied. In the as-cast condition the alloy had almost entirely single fcc phase structure with insignificant amount of the B2 particles. The-as-cast alloy had low strength but high ductility. The alloy was cold rolled and annealed at 800 and 900˚C for different duration (1 min - 50 hours). As a result, fully or partially recrystallized fine-grained fcc matrix with a significant amount (~20%) of the B2 particles was produced. Such a complex microstructure promoted high strength (ultimate tensile strength up to 1300 MPa) with reasonable ductility.

Phase diagram



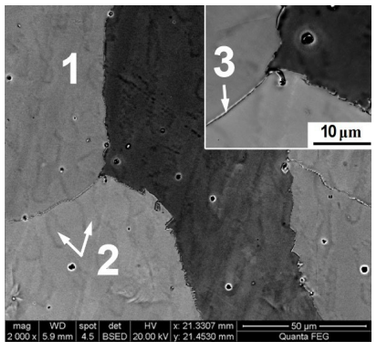
Mechanical properties

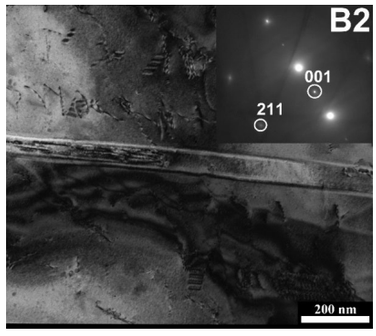




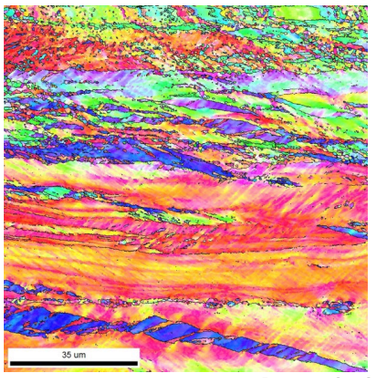
Microstructures

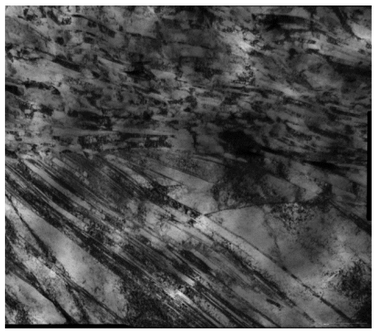
As-cast



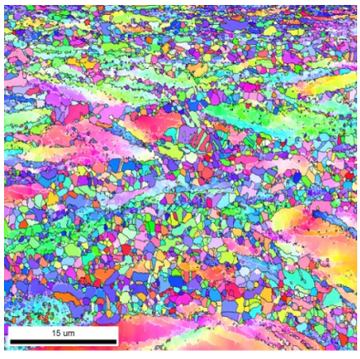


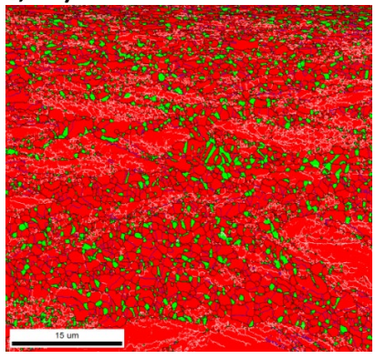
Cold-rolled



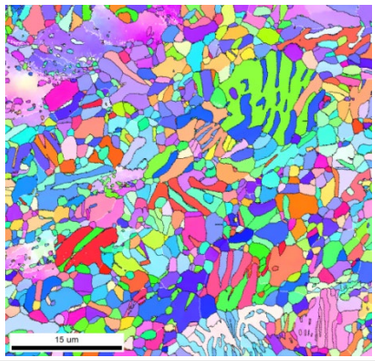


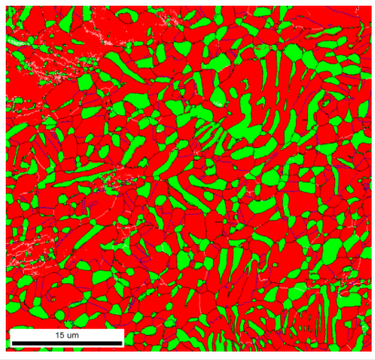
Annealed (800˚C, 1h)





Annealed (800˚C, 50h)





Acknowledgements

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