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MECHANICAL PROPERTIES AND DEFORMATION BEHAVIOUR OF NOVEL REFRACTORY HIGH-ENTROPY ALLOYS WITH A BCC-B2 STRUCTURE

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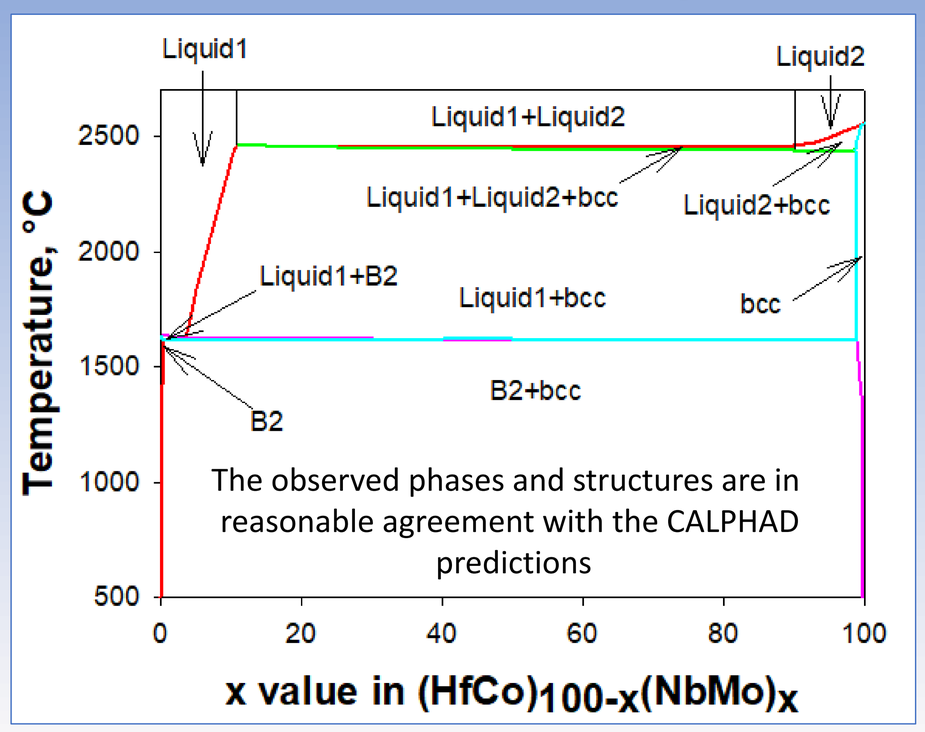
Abstract

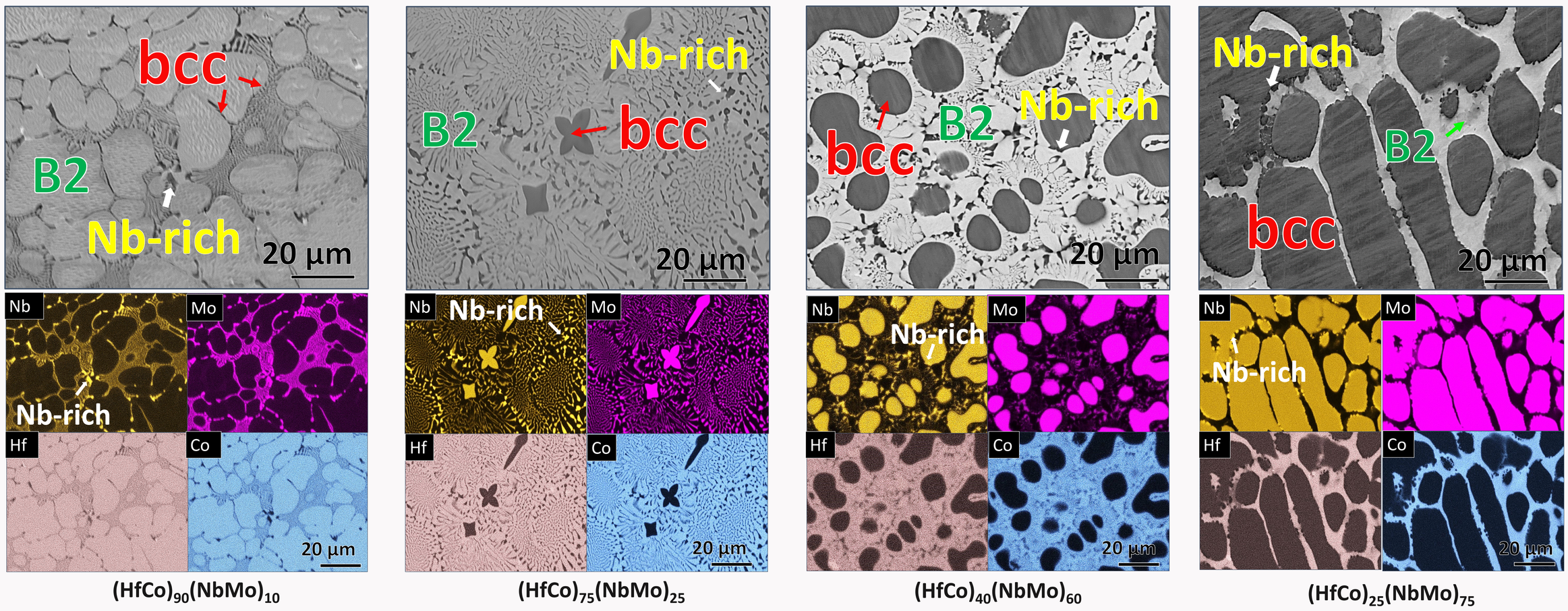
Conventional paradigm says that intermetallic should be embedded as coherent reinforcements in a disordered and soft matrix to ensure balanced mechanical properties. When intermetallics stand as a matrix, alloys are anticipated to be strong yet brittle. For instance, in the recently developed refractory high-entropy alloys (RHEAs), a mixture of an intermetallic B2 matrix and coherent bcc particles provided high strength at elevated temperatures but low room-temperature plasticity. Meantime, several works reported that some B2 phases, namely Co-X (X = Ti, Zr, Hf), could be ductile even under tension at room temperature. These compounds had high melting points, albeit they showed low yield strength. In this study, we demonstrated that body-centred cubic particles could strengthen such B2 compounds in a quite unexpected manner. The resulted heterogeneous, dual-phase structure ensured a better strength-plasticity combination compared to initial single-phase counterparts. The composition-structure-property relationships and possibilities for further improvements of properties are discussed.

Keywords: high entropy alloy; B2 phase; deformation behaviour

CALculation of PHAse Diagrams



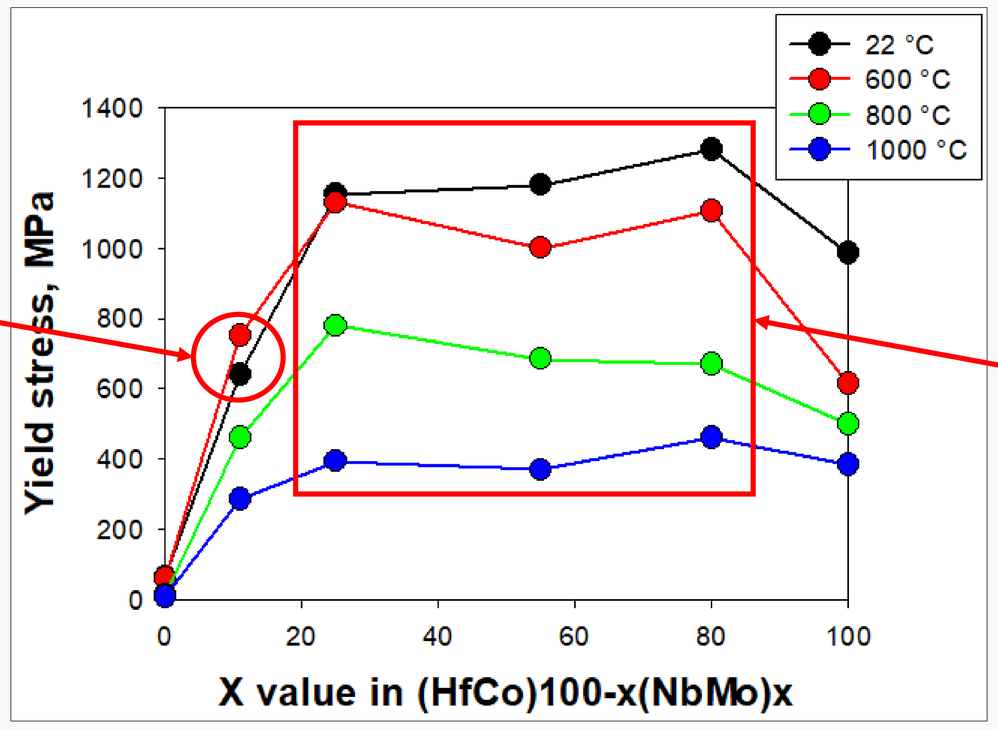
Microstructure



Disordered (Nb, Mo)-rich bcc and ordered (Hf, Co)-rich B2 phases

Mechanical properties

The $(HfCo)_{90}(NbMo)_{10}$ alloy with a nearly single-phase B2 phase structure (87%) demonstrated a yield strength anomaly (YSA)



The $(HfCo)_{75}(NbMo)_{25}$, $(HfCo)_{40}(NbMo)_{60}$, $(HfCo)_{25}(NbMo)_{75}$ alloys had high strength (more then 1000 MPa at 22°C and about 400 MPa at 1000°C) and decent ductility.

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