HIGH ENTROPY TRANSITION METAL CARBIDES

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Since their discovery in 2004, High Entropy Alloys (HEAs) have become a major research area in the field of metallurgy. These materials are typically single-phase mixtures of several (>4) different alloying elements in equi- or near-equiatomic proportions. The result is a material which has structural order, yet chemical disorder; an arrangement which has been reported to lead to enhanced mechanical, physical and chemical properties. Where previously it was believed that the mixing of elements in this way would lead to impractical multi-phase and brittle intermetallic materials, the discovery that single phase solid solutions can be stabilised by their high configurational entropy has opened up a wide new range of useful compositional space to be explored 1.

The ‘entropy-stabilised materials’ concept has recently been successfully applied to metal oxide2 and transition metal diboride3 systems, sparking significant interest in the ceramics, and particularly the Ultrahigh Temperature Ceramics (UHTCs), community. These single-phase materials consist of a chemically ordered anion sublattice (O or B) and a chemically disordered metal cation sublattice; and initial testing suggests that these materials may possess enhanced hardness and oxidation resistance.

We report on the fabrication of entropy-stabilised UHTC refractory metal carbides. It is shown that it is possible to produce bulk homogeneous high entropy carbides. Our findings include densification trials, multi-scale microstructural investigations, and mechanical and physical properties characterisation. The significance of the work will be discussed in relation to the opportunities created for the development of new UHTCs.

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