Micromechanical modelling of near-eutectic Mo-Zr-B and Mo-Hf-B alloys

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Refractory metals with high melting points are promising candidates to replace Ni-based superalloys in high-temperature applications. Mo-based alloys strengthened with boride phases show promising results in terms of mechanical properties. Such properties are ensured due to the combination of ductile solid solution and creep-resistant reinforcement phases.

In this work, the creep behavior of Mo-Zr-B and Mo-Hf-B near-eutectic alloys are described using a micromechanical mean-field elastoplastic model. The only inelastic phase is considered to be a Mo-rich solid solution. All boride phases are assumed to accommodate strains elastically. All the elastic constants of phases are estimated using density-functional theory. The plastic behavior of the Mo-rich solid solution is approximated using the pure Mo data with a correction due to solid-solution strengthening.

The redistribution of stresses and strains between phases is investigated during the creep loading of material. The influence of the lamellar spacing and morphology of non-eutectic borides is studied in terms of the influence on the high-temperature strength of the above-mentioned materials. The minimal creep rates are compared with experimental values, available in the literature.