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Solid solution hardening in bcc Mo-Ti solid solutions produced via arc-melting

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Theoretical treatment of substitutional solid solution hardening (SSH) in concentrated bcc solid solutions is sparse and the theory of Labusch has been successfully applied to diluted solid solutions only. Recently, with the increased interest in high-entropy alloys, progress has been made in the theoretical description of SSH in concentrated bcc solid solutions. In the present study, Mo-Ti alloys have been investigated due to the wide composition range of bcc solid solutions at room temperature and their relevance as major constituting phase in novel promising high temperature alloys within the Mo-Ti-Si system.

Single-phase bcc Mo-Ti solid solution samples with Ti concentrations from 0 to 80 at% have been synthesized by arc-melting and investigated using X-ray diffraction, scanning electron microscopy methods, and atom probe tomography to evaluate their compositions and microstructures. SSH has been investigated over several length scales using different indentation methods and compression testing. The effect of additional hardening contributions from unavoidable interstitial elements and grain size are discussed. Since the Mo-Ti system is expected to show an increase in Oxygen solubility with increasing Ti content, special focus was put on the role of Oxygen for interstitial SSH. The results are compared and discussed within the context of established SSH theories.

Molybdenum-based alloys, solid solution hardening, multiscale testing, binary alloys