DESIGN, CHARACTERISATION AND PROPERTIES OF MO-TI-FE ALLOYS REINFORCED BY ORDERED INTERMETALLIC PRECIPITATES

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Reinforcement of solid solution matrices with ordered intermetallic precipitates is known to be an effective strategy for obtaining high strength, damage tolerant alloys and has been central to the success of nickel based superalloys. This strategy has also been exploited in a number of bcc-based systems, for example in maraging steels where ferrite is strengthened by $L2_1$ (Heusler) and/or B2 structured intermetallic precipitates. However, only limited studies have explored the possibility of extending this approach to bcc alloys based on refractory metals and titanium.

Recent research has shown that titanium-iron alloys comprising eutectic A2 Ti and B2 TiFe phases may be produced with strengths of over 2.5 GPa, alongside elongations to failures of ~15%. These impressive properties are thought to be a result of a fine microstructural length scale and a high lattice misfit between the phases. Here, we report on the phase equilibria in the Mo-Ti-Fe ternary system. In this system, an extensive two-phase field was identified between B2 TiFe intermetallic phase and the A2 (Ti, Mo) solid solution, that extended to Mo rich compositions. Knowledge of how this phase equilibrium varies with temperature enabled the design of alloys that could be homogenised in the single-phase solid solution and subsequently reinforced by solid state precipitates following a lower temperature heat treatment. The microstructure obtained was finer than has been produced through an invariant reaction and an initial assessment of their mechanical properties revealed substantial strength. The prospects for modifying these alloys to enable their use at higher temperatures will be discussed.

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