EFFECT OF W SUBSTITUTIONS ON THE PHASE STABILITY AND OXIDATION BEHAVIOR OF MO-SI-B ALLOYS

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Mo-Si-B alloys are potential candidate materials for extreme environments, especially at temperature regimes beyond the operating limits of superalloys. Metal rich compositions show excellent creep resistance and fracture toughness, but the oxidation resistance is poor due to low Si and B content. Intermetallic rich compositions show excellent oxidation resistance, but poor fracture toughness. Therefore, the inherent challenge in this system is designing an alloy with excellent prime reliance on its intrinsic oxide scale, with excellent creep and adequate fracture toughness. We address this conundrum by attempting to destabilize the brittle phase A15 Mo_3Si in the intermetallic phase field. In the current work, *ab-initio* calculations were used to evaluate the thermodynamic phase stability of the A15 phase. Experiments indicated that this phase becomes unstable beyond a critical W content (~ 10 atom%). Single crystal studies revealed the site occupancies with W addition to be in accordance with the thermodynamic models. Following studies on phase stability, a series of oxidation experiments were carried out at different temperatures and time intervals with sintered as well as cast alloys. The microstructural length scales and morphologies changed significantly with processing conditions. Transient oxidation studies reveal a strong microstructure dependence of oxidation in this alloy. In addition to transient oxidation studies at 1100 and 1400°C, we shall also present isothermal oxidation behavior of this alloy in the 1100 – 1500°C range. Tungsten additions modify the pesting range of this material, due to the higher volatilization temperature of $(WO_3)_3$. The lower vapor pressure of $(WO_3)_3$, in comparison to $(MoO_3)_3$ also results in a lower initial metal recession, especially in alloys with finer microstructures. The oxidized cross-sections revealed the formation of a continuous borosilicate scale that covers the alloy surface completely resulting in excellent high temperature oxidation resistance.