

## EFFECTS OF COMPOSITIONAL AND MICROSTRUCTURAL VARIATIONS ON THE MECHANICAL AND OXIDATION BEHAVIOR OF MO-SI-B AT ELEVATED TEMPERATURES

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Key Words: Mo-Si-B, Oxidation, Deformation, Alloying

Molybdenum matrix Mo-Si-B materials are promising candidates for high temperature applications in oxidizing environments. The three phase microstructure is an  $\alpha$ Mo matrix containing Mo<sub>3</sub>Si (A15) and Mo<sub>5</sub>SiB<sub>2</sub> (T2) grains, resulting in high hot strength and creep resistance up to 1300C. At this temperature, the formation of a borosilicate surface scale from the two intermetallic phases provides oxidation resistance. Utilization of this material as structural components in gas turbines has the potential to increase the thermodynamic efficiency via increased turbine temperatures. Two efforts will be summarized which separately focused on improvements to the matrix plasticity and 1300C oxidation resistance. The matrix plasticity depends upon (1) the intrinsic ductile to brittle transition of the matrix phase and (2) the constraint placed upon its deformation by the intermetallic phases. To address these two factors, Mo-Si-B materials with varying metallic fractions were produced at reduced processing temperatures. Lowering the process temperatures reduces the amount of silicon solid solution and the subsequent degree of supersaturation. This is a significant factor in the intrinsic DBTT of molybdenum due to the embrittling effects of silicon. Additionally, the increased matrix volume fraction reduces the constraint on its plasticity, lowering the brittle to ductile transition temperature and increasing the toughness. The oxidation resistance was studied for a range of compositions in which the silicon to boron atomic ratio was varied from 1 to 5 and iron, nickel, cobalt, yttria, and manganese were included as minor additions. For the protective surface glass, a silica fraction of 80 to 85% was found to be necessary for the borosilicate to have a sufficiently high viscosity and low oxygen permeability. Higher viscosity compositions failed due to spallation of poorly attached, high silica scales. Lower viscosity compositions failed from continuous oxidation, either through open channels or molybdenum oxide bubbles. The additional minor additives substantially aided the initial spreading of the borosilicate.