Analysis of V and Ti modified Mo-Si-B alloys

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Mo-Si-B alloys are attractive high-temperature structural materials due to their high melting point (above 2000°C), high-temperature strength, good oxidation and creep resistance. In order to reduce the density of Mo-Si-B alloys, Ti and V are promising candidates for alloying. Ti as well as V additions are found to cause strengthening of the alloy at intermediate and high temperatures without decreasing the ductility at room temperature. To understand the effect of Ti and V on the crystal structure of the constituents, the phase fractions of the multi-phase alloy and thus the mechanical properties at a range from ambient temperatures to 1100°C, we investigated different compositions of powder metallurgically (PM) processed Mo-Si-B-X (X=Ti/V) alloys. Due to PM processing oxygen cannot entirely avoided. If oxygen is not trapped in the lattice, it leads to oxide phase formation, and further contributes to strengthen the alloy by particle strengthening. The present investigations focus on the characterization of the constituents by SEM, EBSD and Atom probe tomography (APT), combined with Density Functional Theory (DFT) calculations. Based on the analyses, a conclusion can be drawn about the composition of the phases and the solubility of the elements in the phases. These in turn have an impact on the mechanical properties of the alloy, which will also be considered. For this purpose, compressive creep tests at temperatures over 1000°C and flexural bending tests are carried out, in order to evaluate the strength and fracture toughness of the alloys.