MICROSTRUCTURE AND CREEP RESISTANCE OF TI-RICH MO + MO_5Si_3 + MO_5SiB_2 ALLOYS

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New materials are necessary to increase efficiency of power generation and aircraft engines by higher combustion temperatures. Recently, it was found that alloying with high amounts of Ti replaces Mo_3Si by Mo_5Si_3 and stabilizes the phase field Mo + Mo_5Si_3 + Mo_5SiB_2, which could be beneficial for higher oxidation resistance, since Mo_5Si_3 is more oxidation resistant than Mo_3Si. Additional, Ti-rich Mo-Si-B alloys show an increased creep resistance compared to Ti-free Mo-Si-B alloys and a significant reduction in the alloy density. However, using the compositions reported in literature to stabilizing Mo_5Si_3 does not lead to reproducible results. This is most likely due to segregation effects and the formation of metastable phases like Ti_6Si_3. The addition of minor elements can be an option to widen the phase field Mo + Mo_5Si_3 + Mo_5SiB_2 as a function of Ti concentration.

In this study we want to show the efficiency of such minor alloying additions on the stability of Ti-rich Mo + Mo_5Si_3 + Mo_5SiB_2 alloys. This was done by CALPHAD calculations using the commercial Pandat software for several elements such as Al, Cr, Fe, Hf and Zr. Fe seems to be the most promising candidate for stabilizing Mo_5Si_3. Experimental evaluation was exemplified with Mo-12.5Si-8.5B-xTi-2Fe and Mo-9Si-8B-xTi-2Fe model alloys to determine possible concentration ranges of Ti. Those alloys were produced by repetitive arc-melting of high-purity metals, Si and B in a Zirconium gettered high-purity argon atmosphere, followed by homogenization treatment at different temperatures for various times in a high-purity argon atmosphere. The identification of the resulting phases was done by XRD, SEM and EDS/ESMA analysis. Additionally, the creep resistance of those alloys was determined at temperatures ranging from 1100 to 1300°C and correlated to their microstructural features.