Assessment of the Isothermal Section in the V-Rich V–Si–B System at 1400 °C

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Most high-temperature properties, e.g. high-temperature strength and creep resistance, correlate with the high melting temperature. Thus, vanadium-based alloys are promising candidates for high-temperature structural applications due to the high melting temperature of vanadium and a comparably low density. V-Si-B alloys are one of the most promising vanadium-based alloys because the addition of Si and B can improve the oxidation resistance by facilitating the formation of a protective silica layer primarily through the intermetallic phases such as V_3Si, V_5Si_3 and V_5SiB_2.

The latest systematic experimental investigation of the isothermal section of the V-Si-B system was carried out by Nunes et al. at 1600 °C. They produced the samples via arc-melting under argon followed by a heat treatment at 1600 °C for 24/ 72 h under a high vacuum). Based on WDS measurements, they proposed the isothermal section of the V-Si-B system at 1600 °C in the V_{ss}–VB–VSi_2 region of the V-Si-B system.

Most recently, we have observed a new ternary phase, V_8SiB_4, in the alloy V-5Si-9B annealed at 1400 °C. The new ternary phase has nearly the same composition as the V_5SiB_2 phase in the V_{ss}–V_3B_2–V_5SiB_2 phase field at 1600 °C but a different crystal structure. The presence of the new ternary phase at 1400 °C indicates the major difference between the isothermal sections of the V-rich V-Si-B system at 1400 °C and 1600 °C. Thus, this work aims to experimentally investigate the isothermal section of the V-rich V-Si-B system, especially at 1400 °C.