PHASE EQUILIBRIA IN THE NB-SI-GE PHASE DIAGRAM

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Niobium silicide-based in-situ composites have the potential to supersede nickel-based superalloys due to their excellent high temperature mechanical properties and low density. A thermodynamic database is being developed using the CALPHAD method to aid in alloy development. The addition of small amounts of germanium into these systems is of particular interest as it can significantly improve oxidation resistance. For example, germanium is reported to benefit high temperature oxidation resistance of coatings used on refractory silicide alloys by the formation of a glassy $GeO_2.SiO_2$ phase which fills cracks and is impermeable to further oxygen penetration. The effect of germanium on the phases formed in bulk niobium silicide-based in-situ composites is not particularly well understood, and limited data exists in the literature.

To understand the effect of germanium on alloys, a thermodynamic description of the ternary Nb-Si-Ge phase diagram has been developed using the Calphad method. To support thermodynamic modelling samples were produced along the Nb_5Ge_3-Nb_5Si_3 pseudo binary and assessed using XRD. Experimental results show that germanium stabilises the high temperature Nb_5Si_3 (W_5Si_3 prototype) to low temperatures. The thermodynamic assessment will be presented and compared to experimental data from the current work and the literature.