High-Temperature Compressive Behaviour of Directionally Solidified V-9Si-6.5B Eutectic Alloy

Zahra Sabeti[1], Roja Rani Korrayi[2], Andreas Stark[2], Florian Pyczak[2], Manja Krüger[1], Georg Hasemann[1]

[1] *Otto−von−Guericke University Magdeburg, Institute of Materials, Technologies and Mechanics, Universitätsplatz 2, 39106, Magdeburg, Germany*

[2] *Helmholtz-Zentrum Hereon, Institute of Materials Physics, Max-Planck-Straße 1, 21502 Geesthacht, Germany*

Vanadium-based alloys offer lower density and higher melting points compared to nickel-based superalloys, making them attractive alternatives for high-temperature applications. Among these, ternary eutectic V-Si-B alloys are promising candidates for structural use due to their exceptional mechanical properties and thermal stability. This study investigates the compressive strength behaviour of directionally solidified (DS) eutectic V-9Si-6.5B (at.%) alloy at elevated temperatures ranging from 600 °C to 1000 °C. Alloy buttons were initially produced by conventional arc-melting, followed by suction casting to produce rods for directional solidification via a crucible-free float-zone technique at an applied growth velocity of 60 mm/h. Mechanical compressive tests were conducted in either an Ar atmosphere or a vacuum. The microstructures of the compressed specimens were analysed using SEM, and the yield stresses were determined using the 0.2% method. Results indicate that the DSed alloy V-9Si-6.5B compressed along the growth direction exhibits superior high-temperature strength compared to the as-cast reference over a wide temperature range up to 1000 °C. At this temperature, the DS specimen yielded 257 MPa, approximately 43% higher than the as-cast alloy. SEM analysis of the compressed DSed samples indicates a ductile-phase toughening failure mechanism via cracks that mostly propagate within the V5SiB2 phase, while the ductile Vss matrix dissipates the crack energy.