HIGH-TEMPERATURE CREEP STRENGTH AND ROOM-TEMPERATURE FRACTURE TOUGHNESS OF MoSiBTiC ALLOYS

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Quite recently, the author and his coworkers have developed a new high-temperature material based on Mo-Si-B alloys with TiC addition for ultrahigh temperature applications. The alloys are produced not by powder sintering but by casting, and the constituent phases are of Mo solid solution, Mo_5SiB_2 (T_2), (Ti, Mo)C and $(Mo, Ti)_2C$. The density is reduced to less than 9.0 g/cm^3, which is comparable to that of Ni-base superalloys. The high-temperature compressive strength is much stronger than that of commercial heat-resistant molybdenum alloys such as TZM and MHC in a wide high-temperature range. In this paper, the recent progress of our research and development of the MoSiBTiC alloys is reviewed focusing on high-temperature creep strength and room temperature fracture toughness.

The alloy having a primary phase during solidification of (Ti, Mo)C and thus a higher (Ti, Mo)C volume fraction was examined for tensile creep properties, and it was found that the alloy showed typical tensile creep curves accompanying transient, steady-state and acceleration creep stages in all the test conditions. The creep strength was relatively good, for example, the rupture time at 1350 °C under 170 MPa was about 750 h. The stress exponents, *n*, in the temperature range of 1400 – 1600 °C and the stress range of 100 – 300 MPa were ≈ 3 while it was 5 – 6 at 1350 °C, suggesting that the rate-controlling process of creep deformation is different between at and below 1350 °C and at and above 1400 °C in the stress range.

Room-temperature fracture toughness of the MoSiBTiC alloys was measured by three-point or four-point bending tests using Chevron-notched specimens. The alloy having the primary phase of (Ti, Mo)C showed the fracture toughness value of better than 15 MPa(m)$^{1/2}$ at room temperature. The value was better than that of the alloy having a primary phase of Mo_{ss} and thus a higher Mo_{ss} volume fraction. The obtained results indicated that (Ti, Mo)C phase works for improving not only high-temperature strength but also room-temperature fracture toughness.