OXIDATION BEHAVIOR AND MECHANICAL PROPERTIES OF Ti-ENRICHED MoSiBTiC ALLOY

Mi Zhao, Department of Materials Science, Tohoku University
mi.zhao.b5@tohoku.ac.jp
Kyosuke Yoshimi, Department of Materials Science, Tohoku University
Kentaro Yokoyama, Department of Materials Science, Tohoku University

Key Words: Ultra-high temperature materials, MoSiB alloys, Microstructure, Oxidation behavior, Mechanical properties.

Mo-Si-B alloys are one of leading candidates for ultra-high-temperature applications. Macroalloying of Ti to the Mo-Si-B systems improves both strength/density ratio and high-temperature oxidation resistance. However, the study for Ti-added Mo-Si-B alloys have been still limited very much. In this study, Ti-enriched MoSiBTiC alloy with the composition of 38Mo-17Si-5B-20Ti-10TiC (at.%) was addressed from the viewpoint of oxidation and high temperature deformation.

Alloy ingots of the 38Mo-17Si-5B-20Ti-10TiC alloy were prepared by conventional Ar arc-melting. Heat treatment was carried out in vacuum at 1600 or 1700 °C for 24 h. It was found that both the as-cast and heat-treated samples are composed of five phases, i.e., Mo solid solution, Mo_3Si, Mo_5SiB_2, Ti_5Si_3 and TiC. Micro-cracks were often observed across Ti_5Si_3 phase, which were generated by thermal stress caused by the strong thermal expansion anisotropy of Ti_5Si_3. Oxidation behavior was investigated through the specific weight change against time at 1100 and 1300 °C in the atmosphere of p_{O2}/p_{Ar}=0.25. The alloy displayed relatively good oxidation resistance. The oxidation rate coefficient obtained from the oxidation curves was below 10^{-2} $g^2m^{-4}s^{-1}$ even at 1300 °C. This value is comparable to that of the TMS173 nickel-based SX superalloy. Mechanical property was examined by high-temperature compression tests. At 1400 °C, the peak stress reached over 700 MPa, which is at the same level as that of 1st-generation MoSiBTiC alloys [1]. Mechanical properties would be improved by microstructure controlling because the micro-cracking in Ti_5Si_3 degrades the strength and toughness of the alloy. Hot-working should be effective to destroy the inhomogeneous cast microstructure and facilitate microstructure refinement for the Ti-enriched MoSiBTiC alloy.

[1] S. Miyamoto et al., Metall. Mater. Trans. A, 45 (2014) 1112.