MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF TiC-REINFORCED Ti-Mo-Al ALLOYS

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Ti-based alloys have gained extensive attractions in high-temperature engineering applications over the past several decades because of their low density, impressive strength and wear resistance. The continuing demands for advanced structural materials in aerospace and automobile sectors encourage further exploits of Ti-based alloys. Solid-solution hardening has been confirmed as an effective way to improve the mechanical performance of Ti-based alloys. Recent studies suggest that the incorporation of fibrous or particulate reinforcements, such as SiC, TiB and TiC, is necessary to maintain their high specific strength at elevated temperatures. In this study, Ti-Mo-Al ($Ti_{50}Mo_{35}Al_{15}$, at.%) alloys with various TiC additions (1, 5, 10 at.%) were prepared by arc melting technique. We examined the microstructure of these as-cast alloys by X-ray diffractometry (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and high-resolution TEM (HRTEM). Their mechanical properties were systematically evaluated via compression experiments at various temperatures (*T*=298, 1073 and 1273 K), Vickers hardness as well as four-point bending tests. According to the experimental observations, all the alloys prepared in this work were composed of two phases, Ti-Mo-Al solid solution (phase) matrix and TiC particles. Most of the TiC particles precipitated along grain boundaries, following the N-W crystallographic relationship with the matrix. Moreover, the effect of TiC addition on the microstructure of Ti-Mo-Al alloys was mainly manifested in the reduction of average grain size, which is ~80 m in the alloy without TiC but ~30 m in the 10 at.% TiC-added one. The addition of TiC leads to an obvious enhancement of strength at both room and high temperatures, without impairing the ductility. It is worth noting that the maximum flow stress achieved in the TiC-reinforced Ti-Mo-Al alloys at 1273 K is ~400 MPa. Therefore, the reinforcement by TiC is an effective way in improving the mechanical performance of Ti-Mo-Al alloys.