Preparation and high temperature oxidation behavior of silicide-based coating on molybdenum substrate by molten salt electrodeposition

Qian Wang[1], Ya Long Zhang[1, 2], Dan Tong Wang[1], Ming Yang Hong[1], Jun Wei Zhang[1]

[1]*School of Materials and Metallurgy, University of Science and Technology Liaoning, Anshan, 114051, China*

[2] *School of Physics, Xi'an Jiaotong University, Xi'an, 710049, China*

Presenter's e-mail address: qwang12s@alum.imr.ac.cn

Abstract Refractory metal molybdenum (Mo) and its alloys are easily oxidized in high temperature aerobic environment, resulting in a sharp decline in mechanical properties, which limits their applications. In order to improve the high temperature oxidation resistance, $MoSi_2$ coating and Mo-Si-B composite coating were prepared on Mo substrate by molten salt electrodeposition method in this study. The phase composition, microstructure and chemical composition of the coatings were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and electron probe microanalysis (EPMA), and high temperature oxidation behaviors of the two coatings were compared. The results showed that $MoSi_2$ coating exhibited excellent oxidation resistance at 873 K and did not experience "pesting" phenomenon. At medium and high temperatures from 1073 K to 1673 K, a continuous and dense SiO_2 layer was formed on the surface of $MoSi_2$ coating, which could effectively prevent the further oxidation inside the coating. However, the internal diffusion of Si during high temperature oxidation led to the degradation of $MoSi_2$ to Mo_5Si_3 and Mo_3Si with lower Si contents, thus restricting the service life of $MoSi_2$ coating. Compared with single $MoSi_2$ coating, Mo-Si-B composite coating exhibited better oxidation resistance. A continuous and dense SiO_2-B_2O_3 composite oxide film was formed on the surface of Mo-Si-B composite coating after oxidation at 1273 K, which could effectively block the entry of oxygen. The original boride diffusion barrier layer and Mo_5SiB_2 layer formed during oxidation could hinder the internal diffusion of Si and inhibit the degradation of $MoSi_2$.

Keywords Molybdenum; Molten salt electrodeposition; Silicide coating; Oxidation behavior

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