High-Temperature Tribological Behavior of Spark Plasma Sintered CoCrW Alloy

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Abstract CoCrW alloy (Stellite alloy), as a kind of Co-based wear-resistant alloy, is widely used in turbine engines and other high temperature sliding contact parts due to its low friction coefficient and good wear resistance at high temperatures[1, 2]. This work aims to investigate the microstructure and high temperature (400 ~ 800 ℃) tribological properties of CoCrW alloy prepared by spark plasma sintering (SPS). The results indicate that the SPSed CoCrW alloy has uniform microstructure, which consists of γCo, εCo and Cr_7C_3. At the same time, serious abrasive wear occurs at 400 ℃ on account of insufficient oxide debris for the formation of the glaze layer, with a coefficient of 0.27 and a wear rate of 2.55×10^{-4} $mm^3 \cdot N^{-1} \cdot m^{-1}$. However, at 600 ℃, protective oxide islands are formed locally, which weaken the abrasive wear behavior of the hard debris，with a friction coefficient of 0.43 and a wear rate of 4.03×10^{-5} $mm^3 \cdot N^{-1} \cdot m^{-1}$. At 800 ℃, a stable glaze layer composed of Cr_2O_3, $CoCr_2O_4$ and Co_3O_4 is formed on the wear surface of the alloy, and the wear rate decreases by 91% compared with that at 400 ℃, with a friction coefficient of 0.37 and a wear rate of 2.36×10^{-5} $mm^3 \cdot N^{-1} \cdot m^{-1}$. The increase of temperature accelerates the diffusion of ions and the refinement of debris that promotes the sintering of oxide particles on the wear surface and the formation of glaze layer which prevents the contact between friction pairs. The plastic deformation of the subsurface is impeded by the formation of protective glaze layer at 800 ℃ initial wear stage. Then the rapid diffusion of metal and oxygen ions facilitate the formation of Cr-rich oxide layer inside and mixed oxide layer on the surface, which makes the glaze layer more stable.

Keywords CoCrW alloy, microstructure, high temperature tribological properties, high temperature oxidation, spark plasma sintering

Reference

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