Corrosion Properties of $MoSi_2$-Si_3N_4 Nanocomposite in Acidic and Basic Aqueous Environments

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Silicon-based materials, such as $MoSi_2$, Si_3N_4 and SiC are of great interest due to their potential application as high temperature structural materials. However, several factors, including limited fracture toughness and insufficient creep resistance refrain these materials from being employed for structural applications. Composites made of two and three components have been developed to improve the thermo-mechanical properties. Promising results have been observed for composites such as $MoSi_2$-Si_3N_4, $MoSi_2$-SiC, $MoSi_2$-Y_2O_3, and $MoSi_2$-$ZrSiO_4$. They provide an excellent choice as coating materials on metallic substrates. The outstanding oxidation resistance of the materials is the result of the formation of glassy silica (SiO_2) film, which is a very protective, adherent and coherent layer [2]. However, anodic oxidation of these composites has not received much attention. Therefore, the aim of this work was to investigate the corrosion properties of $MoSi_2$-Si_3N_4 composites with varying Si_3N_4 concentartions.

The corrosion behaviour of $MoSi_2$-Si_3N_4 composites with varying Si_3N_4 concentartions was studied in 1.0 M Hydrochloric acid and 4.0 M sodium hydroxide aqueous solutions at room temperature. Potentiodynamic polarization tests were performed using EG&G Princeton Applied Research model 273 potentiostat/galvanostat. A standard three-electrode corrosion flat cell was used with the prepared sample as the working electrode. A platinum foil was used as the counter electrode, and saturated calomel electrode was used as the reference electrode.

Scanning electron microscopy (SEM) was used to characterize the surface microstructure of these composites before and after corrosion testing. X-ray photoelectron spectroscopy was used to analyze the polarized films. Preliminary results obtained with different Si_3N_4 concentrations seem to indicate that the concentration of Si_3N_4 plays an important role in the corrosion behaviour of $MoSi_2$-Si_3N_4 nanocomposites.

References:

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