CARBIDE COMPOSITE COATINGS ON STEEL BY THERMAL REACTIVE DIFFUSION

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Abstract: In the present study the possibility of formation of chromium and vanadium carbide composite coatings on H13 steel by thermal reactive diffusion method was studied. Two different baths (metal and oxide) were used. Field emission scanning electron microscopy (FE-SEM), electron probe micro analyzer (EPMA) and X-ray diffraction analysis (XRD) were applied to study the coatings. After 8 hours of coating at 1000 ˚C, the thickness of the carbide coating layer was 6.5 ± 0.5, 5.2 ± 0.5 μm in metal and oxide baths, respectively. The phase distribution of vanadium-rich regions was 63% and 57% of the total coating deposited in metal and oxide baths, respectively. Before 1 h and between 1 h to 12 h of the coating process, the interface and the diffusion controlled the growth, respectively. Regarding this mechanism of growth, before 1 h, the relationship between coating thickness and time was fitted to a linear function (d=at+b) and from 1 h to 12 h, it was fitted to a parabolic function (d=ct0.5+e). The growth type of carbide layers with carbon diffusion had a high concordance with experimental results. The thickness of produced carbide coating was higher in the metal bath than in the oxide bath. In chromium and vanadium composite coatings, chromium carbide-rich regions and vanadium carbide-rich regions grew as columnar and equiaxed grains, respectively. In metal and oxide baths with equal chromium to vanadium molar ratios, vanadium carbide-rich regions were produced more than chromium carbide-rich regions in the coating. Composite carbide coatings including a base phase of vanadium carbide (V8C7), and reinforce of chromium carbide (Cr23C6, Cr7C3) were formed. This study shows that Thermal Reactive Diffusion method can be used to produce composite coatings by molten salt bath.

Keywords: Thermal Reactive Diffusion, Composite Carbide Coating,chromium carbide, vanadium carbide