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Experimental study of Chromium Silicide phases synthesized by pack cementation process

Silicides such as CrSi2, MnSi1.75, Mg2Si, etc. can be produced by the solid-state reaction between metals and silicon. Reactions of metals with single-crystal silicon have received much attention in both research and production because of their high melting point, high oxidation resistance and satisfactory thermoelectric properties. A variety of techniques have been used to prepare these silicides, ex. ball milling, solid phase reaction, reactive deposition epitaxy, etc. However, chemical vapor deposition (CVD) by pack cementation is an ideal candidate synthesis procedure because it is simple, easily controllable and has low cost. It is a deposition process that comprises two steps, the chemical part, and the solid-state diffusion part. For the reaction of chromium with silicon (Cr-Si), according to the phase diagram of the Cr-Si binary system, the formation of the following phases is possible: CrSi2, CrSi, Cr5Si3 and Cr3Si. Knowledge of the structure and behavior of the Cr-Si phases during heating at temperatures below, and in, the region where silicide formation is expected to occur is of importance. So, this study focuses on the effect of the heating time t and the deposition temperature T on the morphology and structure of the chromium silicide phases synthesized by the pack cementation method. The morphology and the chemical composition of the samples were determined using Scanning Electron Microscopy (SEM) with an Energy Dispersive Spectroscopy (EDS) analyzer. The structure determination and phase identification were performed by X-Ray Diffraction (XRD) analysis. Finally, the oxidation resistance of silicides was investigated by Thermogravimetric Analysis (TGA). The results showed that all four of the silicide phases on the Cr-Si equilibrium diagram were successfully formed at different deposition temperatures and times depending on the Cr concentration. However, only the silicon rich CrSi2 phase formed when an unlimited supply of silicon was present in the system.

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