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Addition of vanadium and niobium to platinum-based alloys

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ABSTRACT

The ternary systems, Pt-Al-V at the Pt-rich corner and Pt-Cr-V were investigated. Phase equilibria data were obtained using scanning electron microscopy with energy dispersive X-ray spectroscopy and X-ray diffraction analyses. The alloys were studied in the as-cast condition, as well as after annealing at 1000°C for 1500 h. Solidification projections were constructed and liquidus surface projections derived for the two systems. Isothermal sections at 1000°C were also determined for the two systems. Two ternary phases were found in the Pt-Al-V system and one in the Pt-Cr-V system. It was concluded that all the phase regions were identified correctly since the results were self-consistent. Four invariant reactions were identified in the Pt-Cr-V system.

Four Pt-Al-Cr-Ru-V and two Pt-Al-Cr-Ru-V-Nb alloys were also investigated and data obtained using scanning electron microscopy with energy dispersive X-ray spectroscopy and X-ray diffraction analyses. The alloys were studied in the as-cast condition, as well as after annealing at 1000°C for 1500 h. The compositions of the alloys were based on a quaternary alloy, Pt_{82}:Al_{12}:Cr_4:Ru_2, which had been identified as one of the alloys having optimum properties in an earlier investigation. Four of the as-cast alloys had a two-phase structure of ~Pt_3Al and (Pt), while two had a single phase, ~Pt_3Al. Vanadium partitioned more to ~Pt_3Al compared to (Pt). There was an improvement in hardness compared to the quaternary alloys which had been identified as having optimum properties.

About 64% of as-cast Pt-Al-V alloys had Vickers hardnesses higher than 500 $HV_{0.3}$ while ~70% of the annealed alloys had hardness higher than 500 $HV_{0.3}$. More than 60% of both as-cast and annealed Pt-Cr-V alloys had hardness values higher than 600 $HV_{0.3}$. There was a general increase in hardness after annealing Pt-Cr-V alloys. Hardness increased with V content in the higher order alloys, and also the annealed alloys had higher hardness compared to the as-cast ones.