LEVITATION QUENCHING OF COBALT AND COBALT BASE ALLOYS

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It is a well known fact that cobalt plays an important role in the cemented carbide industry. As the claims [1] of the existence of a high-temperature hcp γ-Co phase do not seem satisfactorily established, we tried to resolve the problem using levitation quenched Co and Co-WC alloys.

Sintered 99,9% pure Co and Co-WC 6-10 mm dia spheres were levitation melted in a radiofrequency elctromagnetic field[2], then quenched in various fluid media or between highly polished cemented carbide plates.

Pure cobalt was levitation melted in air, then quenched in liquid nitrogen, or water, or between carbide plates. In the case of quenching in liquid nitrogen the melted drop broke up into a number of bright black spherical droplets, consisting of an hcp metallic cobalt core and a massive fcc high-temperature CoO envelope. When quenched in water, the cobalt drop did not break up but only became deformed. Structurally it consisted of metallic hcp cobalt with traces of an fcc α-Co phase. When quenched between carbide plates, about 100 μm thick discs were obtained, consisting of nearly equal parts of hcp and fcc cobalt. We also melted a pure cobalt sphere in vacuum of about 10^2 Pa and then quenched it between carbide plates. A mixture of hcp and fcc cobalt was again the result, though this time the fcc reflexions were more intense. On the basis of our experimental results we may conclude that the previously observed hcp γ-Co phase is in reality a low-temperature hcp ε-Co phase stabilized by oxygen.

Co-WC alloys with WC concentrations of up to 40 wt. % were levitation melted in air and quenched between carbide plates. For alloys with up to 15 wt. % WC, the structure was again a mixture of hcp and fcc cobalt. Alloys with more than 15 wt. % WC were face centered cubic. The dependence of the lattice parameter of these solid solutions on WC concentration is shown in Fig. 1 together with Voigt's results, obtained with conventionally quenched alloys[3].

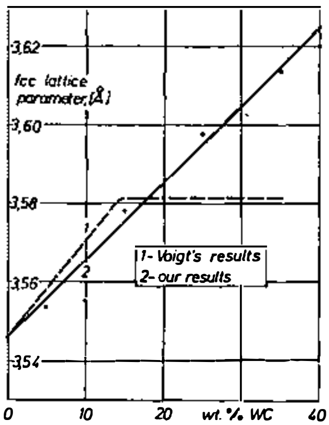

Fig. 1

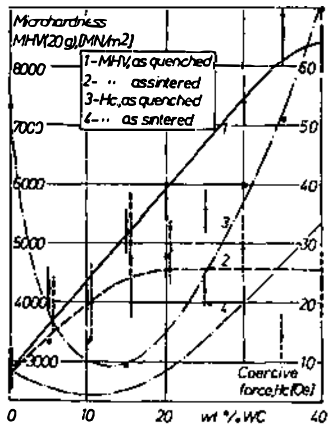

Fig. 2

The microhardness and coercive force of these alloys are shown in Fig.2. The results of this investigation and the respective metalographic analysis allow the conclusion that the solid solubility of WC in Co is metastably shifted from equilibrium 14[3] to over 35 wt. %.

References

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