Cracks in hardmetals

Fig. a: One of the high temperature failure mechanisms in hardmetal, or cermets, is creep cracking induced by a combination of high temperature and subcritical stress. This specimen of WC-6 % Co was heated to 850 °C, near to the ductile-brittle transition temperature. A brittle pre-crack had been induced by indenting at room temperature. When a similar specimen was heated to the same temperature, and subjected only to an instantaneous load, no crack extension was observed. This specimen was held at load for 12 minutes, and extensive crack growth occurred. In particular, evidence can be seen of secondary microcracking, and void nucleation and growth.

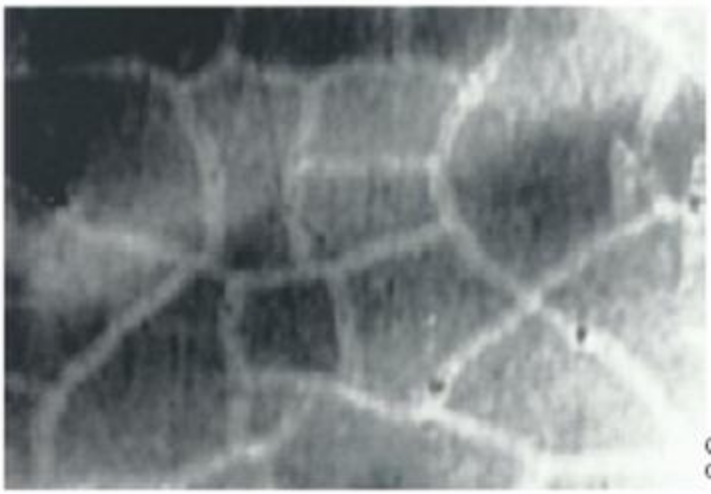

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Fig. b: This is a hardmetal cutting tool that has been coated with a film of TiN a few microns thick, to improve the wear resistance. The film was deposited by chemical vapour deposition at elevated temperature. In the subsequent cooling the ceramic contracts more than the metal, setting up compressive thermal stresses in the coating. Thermal stress relief cracks form as a result, but they are difficult to see by most techniques, because the thermal stresses cause them to be tightly closed. In this acoustic image they appear bright; the contrast associated with them appears broader than the cracks themselves because of the strong Rayleigh scattering.