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Comparative investigation of the Ni and the Fe effect on the structure andmechanical response of a WC-W-Ni hardmetal obtained by infiltration

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Abstract: In the present work, and in order to enhance the efficiency of drilling tools for the oil and gas industry, theinfluence and performance of Ni and Fe during spontaneous infiltration on a WC-W-Ni composite materialmechanical behaviour was addressed. Solid-state activity of Fe and Ni during infiltration exhibits partial dissolution in the metallic binder. The chemical affinity between Fe and Ni, provided by the Fe powder and thebinder respectively, derived on the formation of the (Fe, Ni) solid solution and FeNi3 intermetallic precipitates inthe particle/matrix diffusion region, with a hardness (12 GPa) close to that of WC and high elastic modulus (230 GPa). Furthermore, the diffusion of Fe to the matrix leads to the formation of sub-micrometer precipitatesof ?-Fe with some (Ni, Mn) in solid solution and of Ni3Sn with a small amount of Cu dissolved, driving to anincrease of about 30% in its elastic modulus, and without appreciable effect in the hardness observed.

Keywords : Metal matrix composites, Liquid-solid reactions, Precipitation, powder metallurgy, diffusion, mechanical properties