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MICROSTRUCTURE EVOLUTION AND PHASE FORMATION OF BULK WC-CO COMPOSITES DURING CARBOTHERMAL REDUCTION AND REACTIVE SINTERING FROM WO_3, $COWO_4$ AND C MIXTURES

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A new technology for production of bulk WC-Co composites from the mixture of WO_3, $CoWO_4$ an C by way of carbothermal reduction in combination with reactive sintering was developed. Waste hardmetal parts with 15 wt.% Co from hardmetal production were fully oxidized into mixture of WO_3 and $CoWO_4$ at 850 °C in rotary kiln. Dense fine-grained compositions were fabricated from the oxide micture powders of WO_3, $CoWO_4$ and C by high energy milling in attritor and conventional ball mill. The oxide powders mixtures with carbon in the form of graphite with nanocrystalline size were pressed to compacts. The green parts were carbothermaly reduced into WC and Co in vacuum oven. During carbothermal reduction the tungsten carbide and cobalt were formed and during liquid phase sintering the WC-Co alloy was formed in one cycle. The influence of different carbon content on the phase composition, mechanical properties and linear shrinkage during solid and liquid state sintering is presented. The microstructure of reactive sintered WC-Co compositions is fine-grained and identical with the original WC-Co microstructure. The amount of additional carbon has a significant influence to the phase composition and mechanical properties of recycled hardmetals.

Keywords: Hardmetal, Recycling, Microstructure Evolution, Shrinkage, Carbothermal Reduction,