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PHASE CHANGE OF NIOBIUM CARBIDE THROUGH HIGH-TEMPERATURE ANNEALING

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Niobium carbide (NbC) is a refractory ceramic which possesses good mechanical properties, although little in-depth research has been conducted until recently. It has the potential to overtake tungsten carbide (WC) as an ultra wear-resistant material, which is used industrially in earth-drilling (bits) and in manufacturing (tools and dies). While possessing comparable hardness and fracture toughness to WC, NbC is less dense, non-toxic, and could offer twice the wear time while in-use.

The objective of this research was to explore one NbC compound ($NbC_{0.695}$) through high-temperature annealing (1547°C) in order to characterize an observed phase change between as-hot-pressed (FCC structure) and 30-hour annealed (HCP structure) states. By annealing two additional samples of $NbC_{0.695}$ at 5-hour and 15-hour intervals, the degree of each phase present (FCC and HCP) in these samples could allow for an extrapolated phase-change point.

Once the samples were annealed, they underwent hardness testing by use of a Vickers micro-indenter. Hardness data were gathered for each sample and compared on a hardness vs. annealing time plot. A hardness peak was postulated between the 5-hour and 15-hour samples.

Additional research will be required to fully characterize this phase change, including the use of XRD and SEM imaging of samples for phase characterization. Additional samples annealed at 8, 10, and 12 hours under the same conditions will be needed to confirm the extrapolated hardness peak of this system.