Contribution ID: **89** Type: **Oral Presentation**

The effect of molybdenum carbide additive on the magnetic and physical properties of Fe based NbC cermets

Tuesday 8 July 2025 11:50 (20 minutes)

Cermets are composite materials that exhibit a unique combination of mechanical and physical properties that favour their application as cutting and wear resistant tools. The tuning of properties for performance is dependent on the interactions between the refractory metal and the magnetic binder. In this work, magnetic, electrical and thermal properties of Fe-based Niobium Carbide cermets were investigated using Mössbauer spectroscopy and Physical Property Measurement System. Niobium carbide cermets containing 12 wt% Fe and 12 wt% FeNi were vacuum sintered at 1390℃ with Mo₂C additives. The room temperature Mössbauer spectrum for the Fe based NbC milled powders is primarily ferromagnetic with a magnetic field of 32 T consistent with α-Fe. The spectrum also exhibits a small paramagnetic doublet with an isomer shift of 0.188 mm/s and a quadrupole splitting of 0.816 mm/s which can be assigned to amorphous Fe₂O₃. The Mössbauer spectrum for the sintered NbC-12Fe grade show three ferromagnetic phases in the binder with magnetic fields ranging from 29 T to 33 T. A small paramagnetic phase is observed which increases with the addition of Mo₂C. The NbC-12FeNi spectrum is primarily paramagnetic, ɣ-FeNi with a minor ferromagnetic component. The addition of molybdenum carbide to NbC-FeNi resulted in a paramagnetic structure as compared to NbC-Fe where the spectrum is characterised by ferromagnetic behaviour. The VSM measurements at 2 K reveal several competing strong ferromagnetic fields present in the NbC-Fe and NbC-FeNi cermets. At room temperature (300 K), however, the NbC-Fe has a weak ferromagnetic structure, whilst strong paramagnetic phases were observed in the FeNi binder systems. The addition of Mo₂C in the NbC-Fe cermet results in a strong paramagnetic phase with a weak coercive field. The NbC cermets have significantly lower thermal conductivity values compared to WC hardmetals. The addition of Mo₂C does not appear to have a significant effect on the thermal conductivity of the Fe based NbC cermets. The data will be presented and discussed in the presentation.

Apply for student award at which level:

PhD

Consent on use of personal information: Abstract Submission

Yes, I ACCEPT

Primary author: PETERS, Gerrard (University of the Witwatersrand)

Co-authors: Prof. NAIDOO, Deena (University of the Witwatersrand); Prof. GENGA, Rodney (University of the Witwatersrand); Prof. WAMWANGI, Daniel (University of the Witwatersrand); Dr MOUANE, Othmane (University of the Witwatersrand)

Presenter: PETERS, Gerrard (University of the Witwatersrand)

Session Classification: Physics of Condensed Matter and Materials

Track Classification: Track A - Physics of Condensed Matter and Materials