Universität des Saarlandes, Funktionswerkstoffe
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Master Thesis

"High-resolution investigation of microstructural properties of sintered transition metal alloys Ti(C,N) and Zr(C,N)".

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Transition metal nitrides, carbides and carbonitrides are a special set of alloys that have a special combination of ceramic- and metal-like properties, like chemical and thermal stability, high thermal and electrical conductivity, high hardness and stiffness in comparison to conventional ceramics. Moreover, compounds of early transition metals belong to the **ultra-high temperature ceramic (UHTC)** materials. As an example, the highest melting temperature of any known materials are tantalum, hafnium, zirconium and niobium carbides. [1,2]. These set of properties make these materials capable of performing very well in harsh and extreme environments like metal cutting, **nuclear energy sector**, **aerospace**, **microelectronic**...

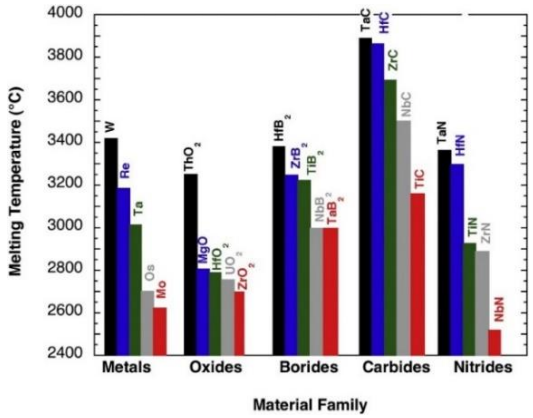

Figure 1: A comparison of the melting temperatures of the most refractry members of several classes of materials. Several borides, carbides,and nitrides havemelting temperatures above 3000°C and are considered ultra high-temperature ceramics. (W.G. Fahrenholtz et al., J. Am. Ceram. Soc. 90, 2007).

Objectives: Investigation of microstructural properties and chemical composition variations of Ti(C,N) and Zr(C,N) compounds sintered under two different conditions. The characterization will be focused mainly on texture variations, grain size and defects (e.g., porosity). Chemical composition will focus on the comparison between the initial composition of the powders and the sintered product.

Method: Bulk samples of titanium and zirconium carbides and nitrides are produced by hot pressing powders followed by sintering at high temperature around 2000°C with different gases pressure. **Advanced characterization techniques** will be deployed for the investigations (Scanning electron microscopy (**SEM**), Focused Ion Beam (**FIB**), Electron Backscattered Diffraction (**EBSD**)...) and X-ray diffraction.

Network: The project is in collaboration with the worldwide leading company Sandvik Coromant where the samples are produced. The sample preparation and high-resolution characterization will be done at the chair of functional materials.