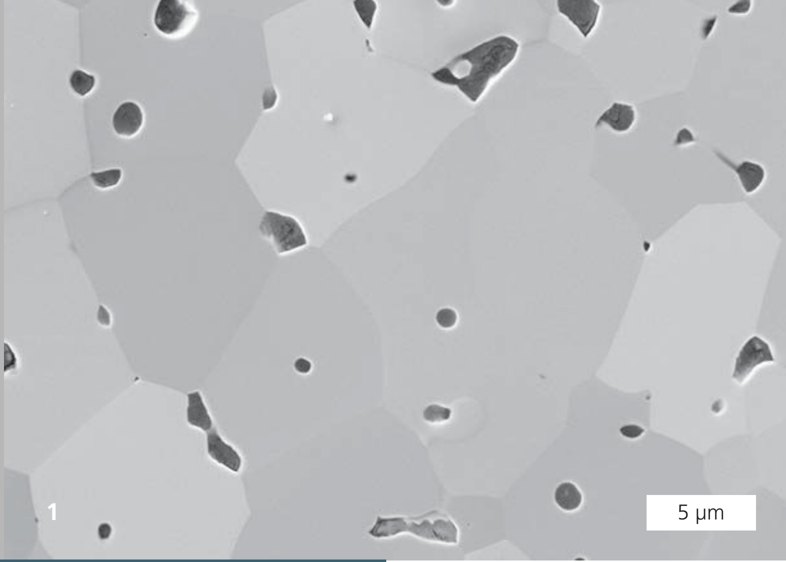

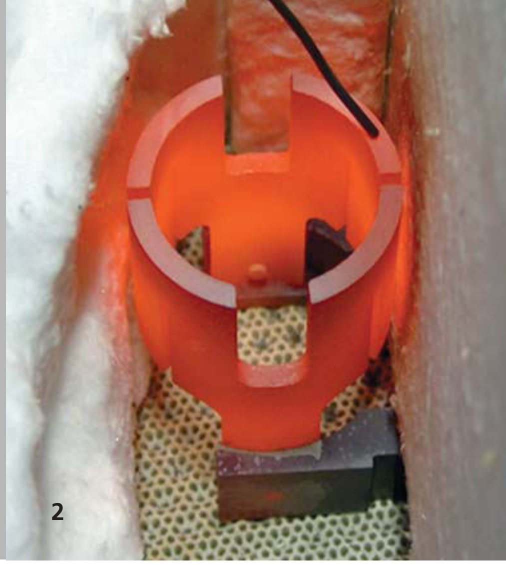

CONDUCTIVE CERAMICS AS ELECTRICAL MATERIALS AT HIGH TEMPERATURES

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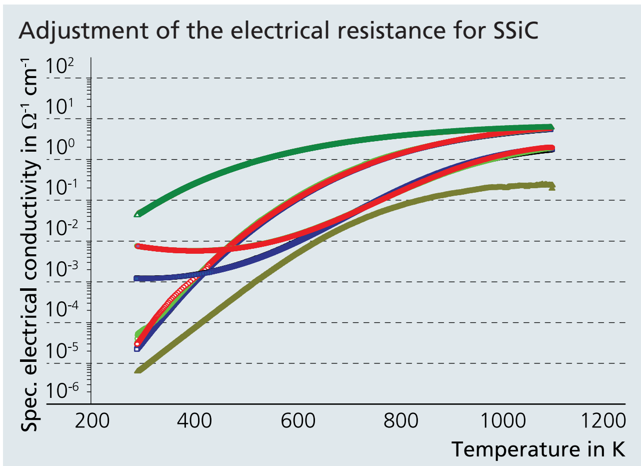
Generally, one intends to expect that ceramic materials behave as electrical insulators. This is absolutely correct for many ceramics but ceramic materials are able to vary their electric properties much more than metals or plastic materials. Ceramic materials are particularly advantageous for electrical and mechanical requirements despite their inherent brittleness and tendency to break. Since there are only little material alternatives, ceramics are frequently used for high-temperature components. Even for temperatures < 500 °C the use of ceramic materials can be desirable because the inherent mechanical and chemical stability of ceramics is almost permanently given.

Metal-like carbides (ZrC, TiC) or nitrides (TiN, TaN), have high electrical conductivity up to 10^5 S/cm, which is decreasing with rising temperature. The mentioned materials are significantly harder, more temperature resistant and show better chemical stability compared to metals or metal alloys. Currently, industrially applicable manufacturing processes for zirconium carbide materials are developed at IKTS to replace tungsten or molybdenum materials for high-temperature applications. Zirconium carbide is characterized by a similarly low vapor pressure at 2000 °C k as tungsten.

Electrical semiconductor ceramics are, for example, silicon carbide, boron carbide or titanium suboxide. Besides a moderate electrical conductivity in the range of 10^{-2} to 10^3 S/cm at room temperature, which can be shifted considerably by several orders of magnitude for one ceramic type, all ceramics are heat resistant above 1000 °C and show outstanding abrasion resistance and chemical stability against aggressive atmospheres. The property spectra of those ceramic materials is extraordinarily flexible, which enables them to solve very specific functional tasks in combination with constructional demands. For instance, heating and sensor functions for temperature control together with mechanical support can be delivered by heating elements made of silicon carbide.

Ceramic composites made of metal-like semiconductive and isolating ceramic components (e.g. Si_3N_4 + SiC + MoSi) or any other composition of various semiconductive ceramics (e.g. SiC+ B_4C) have been manufactured at IKTS and tailored for specific requirements. Such ceramics offer an available base for a very variable multifunctionality. Precise knowledge concerning the specific processing can be gained, which is the fundament for economical competitive materials for future-oriented options in plant construction, mechanical engineering and sensor applications. Material and component development, measurement of electrical conductivity from room temperature up to 1000 °C and the investigation of electronic properties, like carrier concentration or Seebeck coefficient generate the base of application-oriented projects.



1 *Microstructure of pressureless sintered (2000 °C) zirconium carbide.*
2 *Silicon carbide heater.*

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