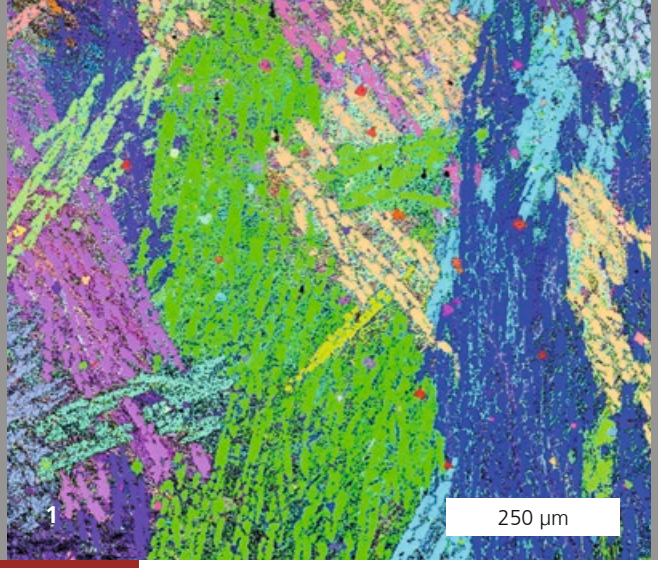
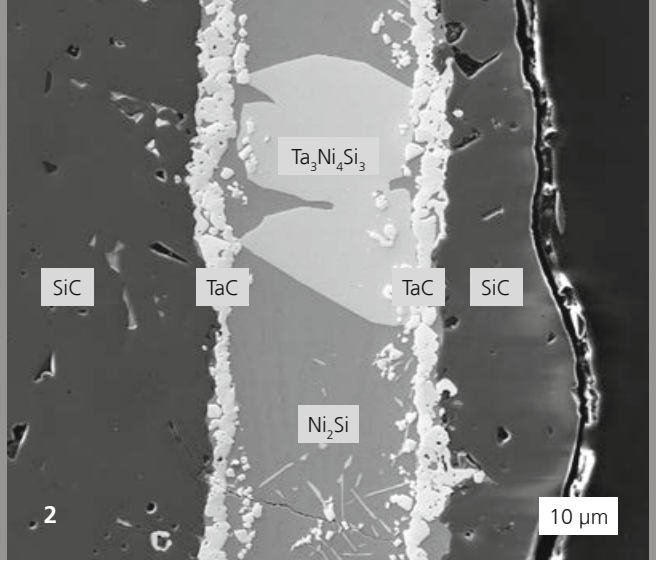



1



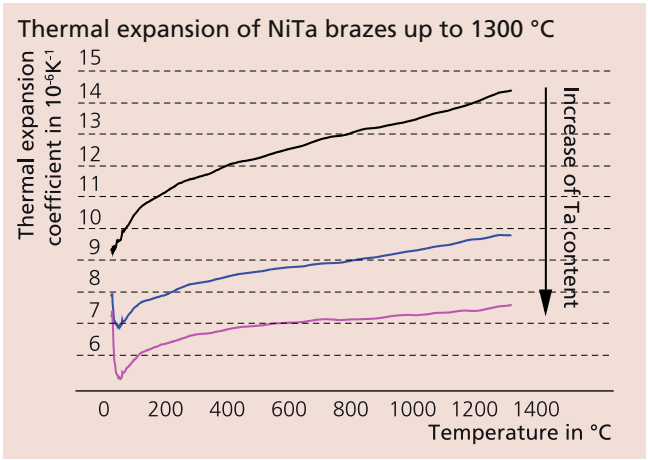

2



# BRAZE DEVELOPMENT FOR HIGH-TEMPERATURE-STABLE CERAMIC COMPOSITES

Dipl.-Ing. Sven Roszeitis, Dr. Hans-Peter Martin

Thanks to their extremely high resistance, ceramic materials are suitable for use at very high temperatures and in chemically aggressive environments. Compared with other materials, significantly longer operating times are therefore possible. In addition, process-optimized ceramics can also increase the energy and material balance of an entire process, e.g. by achieving higher process temperatures or improved thermal insulation or heat conduction. The successful use of ceramic components almost always depends on their optimal integration into the overall system. This results in an increasing demand for ceramic-specific, reliable joints and thus the need to develop new processes and joining materials, such as brazing alloys, for very high application temperatures. At Fraunhofer IKTS, high-temperature stable soldering systems adapted to ceramic materials were manufactured and tested in various applications. Enhanced nickel tantalum solders (NiTa) exhibited relatively high strength even at high operating temperatures when compared to other metallic solders. Using these solders, SiC composites with a flexural strength of 275 MPa at 800 °C were achieved. Adjusting the coefficient of expansion (CTE) in the NiTa system optimized the material compound still further. The chart shows the wide range of expansion coefficients in the NiTa system from $12 \cdot 10^{-6}$ $K^{-1}$ to $6 \cdot 10^{-6}$ $K^{-1}$. In addition, alumina, silicon carbide and zirconium oxide were joined using titanium-aluminum brazing alloys (TiAl) developed at IKTS. These low-cost high-temperature brazing alloys have an oxidation stability of up to 1000 °C, as well as the ductility of certain TiAl compositions, and are therefore suitable for ceramic-ceramic and ceramic-metal composites. Further work is currently underway to investigate whether a combined process of high-temperature brazing and 3D printing can significantly improve the efficiency of additive manufacturing methods for ceramic materials.




**Services offered**

- Development of high-temperature-stable composite materials based on NiTa and TiAl braze compositions
- Development of customer-specific metallic brazes and solders as well as related brazing processes
- Experimental manufacture of ceramic-ceramic and ceramic-metal test composites with metallic brazes

We acknowledge the financial support of the project "SuperHi" by EU, Free State of Saxony and SAB (grant no. 100231806).

1 *EBSD band contrast of a Ni-62Ta38 alloy.*
2 *FESEM of a SiC-Ni62Ta38-SiC joint.*


Contact Hans-Peter Martin • Phone +49 351 2553-7744 • hans-peter.martin@ikts.fraunhofer.de