

Double-Cycle Spark Plasma Sintering of percolating refractory metal–ceramic composites for electrified high-temperature processing

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The electrification of high-temperature industrial processes necessitates the development of a new class of materials that simultaneously withstand extreme environments and exhibit sufficient electrical conductivity. Composites combining refractory metals such as niobium and tantalum with the well-established alumina represent a promising approach to meet these requirements.

By systematic variation of particle size distributions, sintering parameters, and phase contents, key characteristics such as electrical conductivity, mechanical strength, and thermal stability can be adjusted while simultaneously reducing the percolation threshold of the metallic phase. Dense ceramic matrices containing finely distributed, percolating metallic networks can be produced, providing electrical heating capability together with the inherent high-temperature stability of a refractory composite.

A hierarchical composite architecture is realized by crushing the dense primary composite into granules, generating two-phase interpenetrating particles that are subsequently consolidated in a second SPS step. This processing route yields microscopically dense granules embedded in a macroscopically porous framework with reduced shrinkage, enabling additional control over thermomechanical properties while maintaining a conductive material system.

The presented processing strategy demonstrates a versatile pathway toward electrically heatable composites for next-generation high-temperature applications.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

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