Fig. 2
Application of the sealing material onto a plasma-sprayed alumina tube via spraying

High-temperature stable gas-tight sealings for plasma-sprayed ceramic components

LWK PlasmaCeramic GmbH uses a plasma spraying process for the fabrication of ceramic components. In this fabrication technique, a ceramic powder is melted in a plasma burner and ejected towards a metallic target, where the particles coalesce and solidify. The formed part is then either thermally treated to adjust the crystalline structure or is directly finished.
The plasma spraying process offers a high degree of flexibility concerning part geometries. Using this technique, e.g. ceramic pipes with wall thicknesses as low as 1 mm, diameters up to 1000 mm and lengths up to 7000 mm can be fabricated in one step. Various oxide ceramic materials like e.g. alumina, mullite or zirconia can be processed this way.
The resultant components show a lamellar microstructure exhibiting open and closed porosity, which offers favourable properties like a high thermal shock resistance, low thermal conductivity and good chemical stability.
Nevertheless, plasma sprayed ceramic components exhibit open porosity, which restricts their use to applications where the penetration of gas can be tolerated. By applying a gas-tight sealing to these ceramics however, new application fields can be opened up.
For this purpose, LWK PlasmaCeramic and the Fraunhofer Center for High Temperature Materials and Design HTL are conducting a project which aims for the development of a high temperature stable gas-tight sealing for plasma sprayed ceramic components.
In order to provide an effortless implementation of the coating and sealing processes into the industrial fabrication flow, the coating material is supposed to be dispersed in aqueous slurries, which are applicable via simple and cost-efficient means like spraying, painting or dipping. After drying, the coating shall be converted to a gas-tight sealing via thermal treatment. The sealing is to be stable at 1300 °C under atmospheres like air, low pressure or inert gas.
During the course of the project, a coating material has been developed, which can be converted into a covering sealing layer on top of flat and cylindrical plasma sprayed alumina substrates. It was demonstrated that the sealing material can be dispersed in aqueous slurries covering a broad range of viscosities to be applicable to the substrates via spraying, painting or dipping. For the conversion of the applied coating material to a gas-tight sealing material, a thermal treatment procedure has been elaborated, which can also be run in large-scale, industrial furnaces, allowing the sealing of large-sized parts. A thermal cycling treatment at 1300 °C for 10 h showed no effect on the microstructure of the sealing, demonstrating the thermal stability of the sealing materials. The next step is to proof the gas-tightness of the coatings under application-relevant conditions.

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