High-temperature and corrosion-resistant perforated boards for porous burner flame traps by gelcasting

Issendorff Thermoprozesstechnik e.K. (I-TPT) develops and produces porous burners for industrial applications. Unlike common burner technologies, in which the flammable substances react within a sustained flame, porous burners perform a flameless combustion of a pre-mixed and pre-heated gas/air-mixture within a spatially defined reaction zone. This allows for a very efficient thermal use of flammable materials with extremely low emissions of noxious gases, while providing high power density, modulation capability and combustion stability.

Besides the silicon carbide foam structure defining the reaction zone, one crucial component is the so-called flame trap. It serves to separate the combustion from the premixing zone, to pre-heat and to channel the pre-mixed gas/air-mixture towards the reaction zone and to prevent a flash-back of the combustion reactions from the combustion zone backwards into the premixing zone.

Consequently, flame traps in porous burners have to meet several requirements like high thermal, thermomechanical and chemical stability. However, the commonly used perforated vacuum-formed alumina sheets have some major disadvantages. The required boreholes are usually engrafted via drilling, making an upscaling of these technical components costly and inefficient. Furthermore, the material exhibits corrosion and breakup at the contact area to the commonly used silicon carbide foam as well as grain coarsening caused by local hot spots.

In order to eliminate these drawbacks, the Fraunhofer Center for High Temperature Materials and Design HTL and I-TPT carried out the project BayForZirkon, funded by the Bayerische Forschungsstiftung, and developed a gelcasting route for producing perforated cylindrical zirconia boards made of calcium-stabilized zirconia. This material has both a high thermal stability and a high chemical stability towards silicon carbide. Furthermore, the gelcasting of flame trap boards already including boreholes offers a far more efficient production of larger components for larger porous burner systems. Crack-free perforated zirconia boards with diameters up to 200 mm could be manufactured without drilling.

Thermal shock tests were conducted by repeatedly heating the parts up to 1000 °C and then immersing them into water, showing no crack formation. The parts were also implemented as a flame trap in a porous burner set-up for thermal cycling tests. The burner was run at full power up to 1300 °C for up to 10 h and subsequently rapidly cooled by switching off the gas supply. In all cases, no crack formation or degradation could be detected.

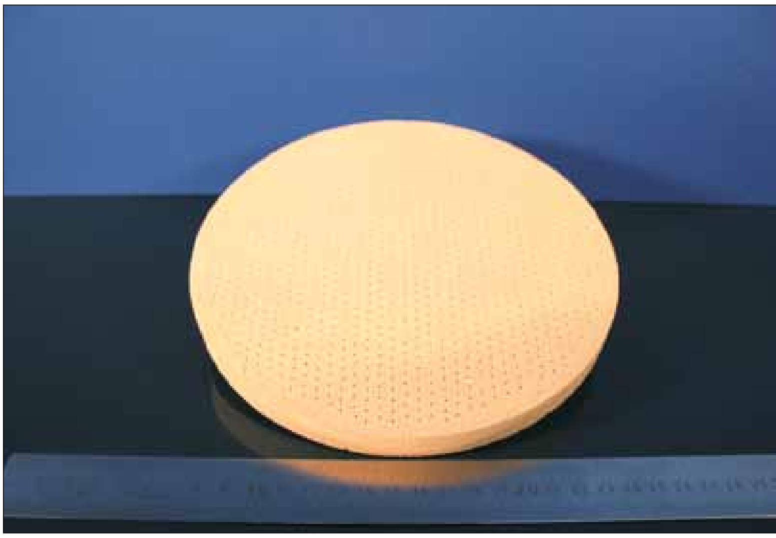

Fig. 2
Cylindrical perforated zirconia board at Ø 200 mm with Ø 1 mm boreholes manufactured by gelcasting

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