Geometry and performance of PTC-honeycomb heaters

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Abstract

Today ceramic honeycombs fabricated by extrusion technology are well established for chemical catalysis in a wide field of applications. Ceramic honeycombs based on semiconducting barium titanate seam to be interesting for heating applications especially for heating fluids like air or diesel fuel. But to find acceptance on the market several technical problems have to be solved. The goal of the present work is to fathom the potential of monolithic PTC-heaters in respect to power density in relation to streaming resistance. The results of numerical calculations and experimental measurements for the influence of cell geometry, surface temperature and mass flow on heat transfer and pressure drop at honeycomb heaters in streaming air are reported. Based on experimental results on honeycomb samples the simulation is refined stepwise. A geometry that conforms to special demands for an electrical auxiliary heater for automotive application was found. The predictions of simulation are compared with the experimental data on prototypes with optimised geometry. In connection to this geometry a special electrode design for low voltage applications is presented. Experiences with a surface passivation of the ceramic heater by a sol-gel coating to enhance the climatic durability are discussed.