LOW-TEMPERATURE SINTERING AND FABRICATION RESEARCH OF CERAMICS AND NUMERICAL SIMULATION ON ELASTIC, PRESSURE DROP AND HEAT TRANSFER PROPERTIES OF OPEN CELL FOAMS

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ABSTRACT

Vanadium pentoxide (V_2O_5) was chosen as a sintering aid to lower the sintering temperature of the ZnO–TiO_2 system. The effect of V_2O_5 on the sintering behavior of ZnO–TiO_2 ceramics and cermets was studied as a function of additive percentage and sintering temperature. Then porous alumina ceramics with different porosity were fabricated by two different methods. For both of two methods, the bulk density, porosity, and microstructure of the obtained alumina ceramics were studied.

Open cell foams, as one type of porous materials, are nowadays commercially used in a broad range of applications. A method for the generation of random foam structures, based on Laguerre-Voronoi tessellations of randomly packed spheres with log-normal volume distribution, was proposed. Then a three dimensional random Laguerre-Voronoi foam model was developed to investigate the elastic properties of open cell ceramic foams.

Finally, the pressure drop and heat transfer through open cell foams were investigated. A pressure drop correlation with a universal form was developed based on theoretical grounds and the tortuosity of open cell foams was taken into account for the pressure drop. The developed correlation was validated using numerical simulations. Permeability and friction factor of foams were also evaluated. Then the computed interstitial heat transfer coefficients were investigated. Furthermore, a correlation was given to derive the hydraulic diameter from the ppi number.