ABSTRACT

Porous ceramics have several industrial applications including catalyst support, water, gas filtration and bio-implantation. However, most of the porous ceramics are fabricated using toxic chemicals and submicron size ceramic particles. Here, an environmental friendly gel casting method is employed for fabrication of $MgAl_2O_4$ ceramic foams. The nano-crystalline $MgAl_2O_4$ powders were prepared by a modified auto combustion technique and used as a starting powder in the foam fabrication. The crystalinity of $MgAl_2O_4$ powders was achieved by calcinations of as-prepared powder obtained after combustion. Structural, microstructural and textural analysis showed that the calcined (900 °C) powder found to be nanocrystalline and phase pure. The aqueous suspensions were prepared using nanocrystalline $MgAl_2O_4$ particles and egg white as a gelling and foaming agent. The rheological properties of ceramic suspensions were investigated using parallel plate viscometer. The studies indicate that the viscosity of egg albumin-based ceramic suspension exhibits a typical shear thinning behavior and significantly influenced by particle loading. Furthermore, the high viscosity of ceramic suspensions was tailored by incorporation of sucrose molecules. The egg white-based ceramic suspensions were ball milled to obtain wet foams. The wet foams were dried in an air oven and subsequently sintered at high temperature (1600 °C). The sintered ceramic foams were found to be cellular in nature and porous as confirmed by scanning electron microscopy and mercury porosimetry studies, respectively. $MgAl_2O_4$ nanoparticles loading plays a significant role in controlling microstructural properties i.e. cell size, pore size distribution, the amount of porosity, and pore morphology in the final sintered bodies. The flexural strength and hardness of the obtained ceramic foams have been investigated. It was found that initial solid loading significantly influenced the mechanical properties of the sintered foams. The obtained porous ceramic body is found to be an efficient catalyst support material for gas sensing application.

Keywords: $MgAl_2O_4$, Ceramic foam, Gel casting, Mechanical properties