4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Fabrication and characterization of composite materials based on porous ceramic preform infiltrated by elastomer

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Accepted for publication on 17th June 2015

For many years successive growth of the interest in composites is noticed. The progress is determined by continued demand for development of stiffer, lighter and stronger materials. Most works have focused on particle- or fiber reinforced composites [1-3]. They are characterized by very good stiffness, wear resistance and compressive strength by relatively low density. However, there are limitations concerning the possible to achieve volume fraction of reinforcement in the matrix. Moreover, particles or fibers comprise non-continuous phase and a full interpenetration between components does not occur. Consequently, it can cause decrease of degree of inter connectivity between the phases. In this context, new group of materials called Interpenetrating Phase Composites (IPCs) was developed.

The paper presents the experimental results of fabrication and characterization of ceramic- elastomer composites. They were obtained using pressure infiltration of porous ceramics by elastomer. As a result the composites, in which two phases are interpenetrating three-dimensionally and topologically throughout the microstructure, were obtained. In order to enhance mechanical properties of preforms high isostatic pressure method was utilized. The obtained ceramic preforms with porosity gradient in the range of 20-40% as well as composites were characterized by X-ray tomography. Effect of volume fraction of pores on residual porosity of composites was examined. These results are in accordance with SEM images which show the microstructure of composites without any delaminations and voids. Such composites exhibit high initial strength with the ability to sustain large deformations due to combining the ceramic stiffness and rubbery elasticity of elastomer. Static compression tests for the obtained composites were carried out and the energy dissipated during compression was calculated as the area under the stress-strain curve. The dynamic behavior of the composite was investigated using the split Hopkinson pressure bar technique. It was found that ceramic-elastomer composites effectively dissipate the energy. Moreover, ballistic test was carried out using armor piercing bullets.

The studies were supported by the Polish National Center for Research and Development as grant no. N R15 0021 06.

Keywords: Ceramic-matrix composite, Ceramic, Mechanical properties, Damage mechanics, Scanning electron microscopy