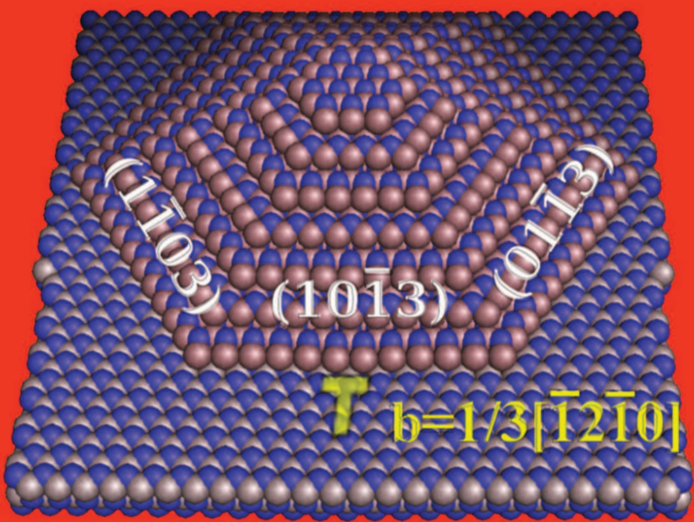
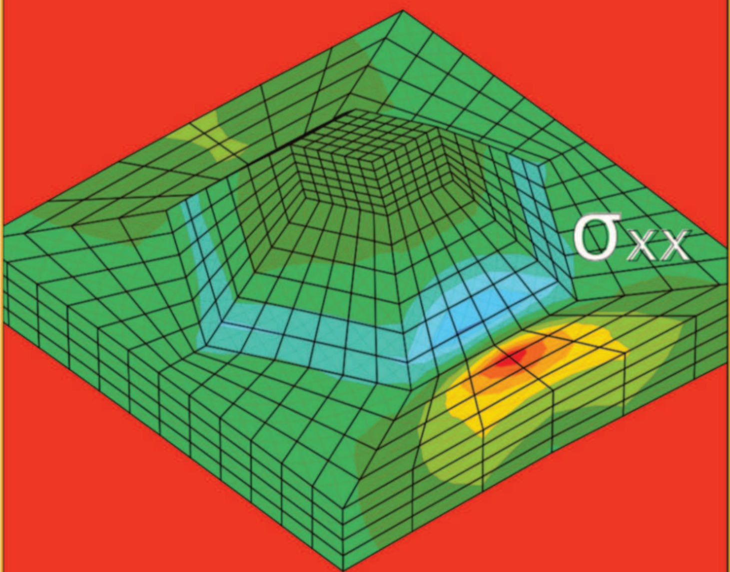
Paweł Dłużewski,
Grzegorz Jurczak,
Toby D. Young
(editors)



Book of abstracts

3rd International Conference on Material Modelling
incorporating the
13th European Mechanics of Materials Conference



September 8th - 11th, 2013
Warsaw, Poland

Instytut Podstawowych Problemów Techniki
Polska Akademia Nauk

Paweł Dłużewski, Grzegorz Jurczak, Toby D. Young (editors)

Book of Abstracts

Third International Conference on Material Modelling

incorporating the

Thirteenth European Mechanics of Materials Conference

September 8–11, 2013
Warsaw, Poland

Book of Abstracts
Third International Conference on Material Modelling
incorporating the
Thirteenth European Mechanics of Materials Conference

September 8–11, 2013
Warsaw, Poland

ISBN 978-83-83687-83-8

The Compressive Strength of Ceramic Open-Cell Foams with the Variability of Cell Sizes

Zdzisław Nowak [1], Marcin Nowak[1], Ryszard Pęcherski[1], Marek Potoczek[2], and Romana Ewa Śliwa[2]

[1]Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawińskiego 5B, 02-106 Warsaw, Poland

[2]Rzeszow University of Technology, W. Pola 2, 35-959 Rzeszow, Poland

e-mail: znowak@ippt.gov.pl

New aeronautic materials are obtained by liquid metal infiltration into a ceramic foam, called a preform. Ceramic preforms are produced by a new method of manufacturing of porous ceramics foams known as gelcasting. Porous ceramics fabricated by this method is characterized by a continuous network of spherical cells interconnected by circular windows. The open porosity due to the presence of windows creates good hydro-dynamical properties for liquid metals infiltration. For better understanding mechanical properties of such composites a numerical model of ceramic foam is needed, see e. g. ref. [1-4].

Geometry of ceramic foams can be generated in two steps. First, the coordinates of the center point of the spherical bubbles and its diameter are produced by PYTHON scripts. The diameters of spherical bubbles were estimated from microtomography and scanning electron microscopy images. On the other hand, the coordinates of the center points are determined in such a way that the bubbles have to intersect with each other. Finally, the intersecting bubbles are subtracted from the bulk block of any shape. Using this information, numerical foam model was proposed (Fig. 1) and good agreement between numerical model and real foam structure from microtomography was obtained.

In this work we present a numerical model of real foam of alumina with different cell sizes and discuss its mechanical properties using several examples. The numerical simulations of uni-axial compression test have been performed. The bottom surface of the sample was full constrained and the top surface of this sample was moved parallel to the z- axis. The force was resulted from the final step of displacement in simulation. As a result the compressive strength of the investigated foams with porosities changing from 60 to 95 % were determined.

Acknowledgments Financial support of Structural Funds in the Operational Programme - Innovative Economy (IE OP) financed from the European Regional Development Fund - Project "Modern material technologies in aerospace industry", Nr POIG.01.01.02-00-015/08-00 is gratefully acknowledged

References

[1] S. Sihn and A.K. Roy. Modeling and prediction of bulk properties of open-cell carbon foam. Journal of the Mechanics and Physics of Solids, 52, 167-191,2004.
[2] Y.X. Gan, C. Chen and Y.P. Shen. Three-dimensional modeling of the mechanical property of linearly elastic open cell foams. International Journal of Solids and Structures, 42, 6628-6642, 2005.
[3] A. P. Roberts and E. J. Garboczi. Elastic properties of model random three-dimensional open-cell solids. Journal of the Mechanics and Physics of Solids, 50, 33-55, 2002.
[4] Y. Takahashi, D. Okumura and N. Ohno. Yield and buckling behavior of Kelvin open-cell foams subjected to uniaxial compression. International Jurnal of Mechanical Sciences. 52, 377-385, 2010.

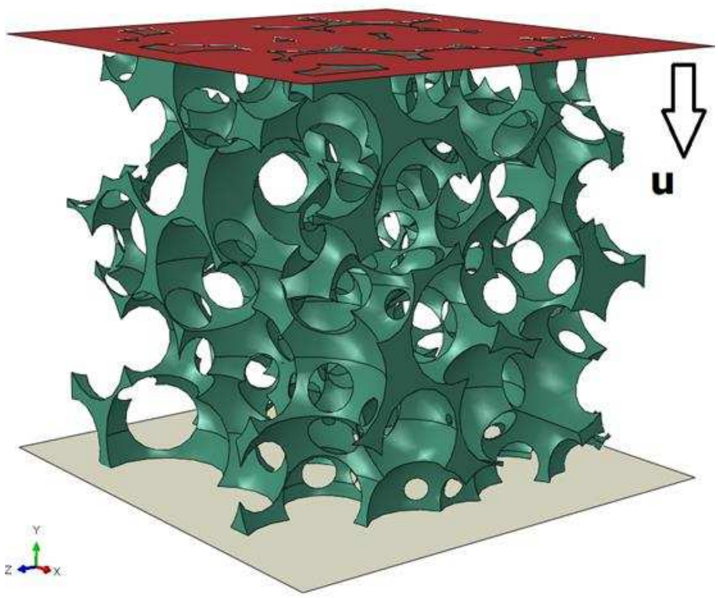


Fig.1. Example of numerical foam structure used in numerical simulations of the compression tests with 90 % porosity.