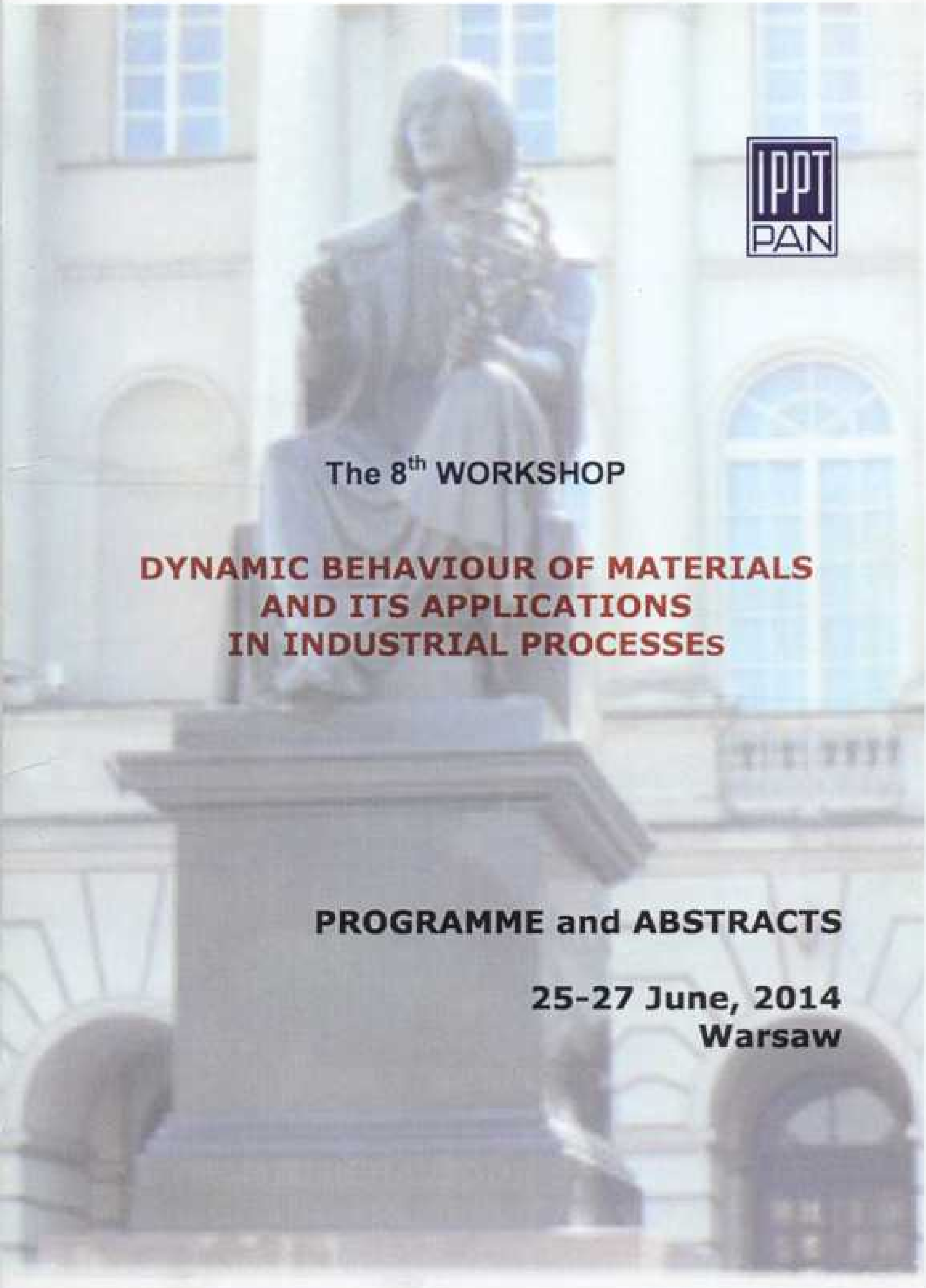

IPPT PAN

The 8th WORKSHOP

DYNAMIC BEHAVIOUR OF MATERIALS AND ITS APPLICATIONS IN INDUSTRIAL PROCESSEs

PROGRAMME and ABSTRACTS

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APPLICATION OF PERIODIC UNIT CELL FOR MODELING OF POROUS MATERIALS

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1. General

Nowadays, porous materials are often employed in automotive and aerospace industries. The main reason for this is their mechanical properties such as low density, capability of energy absorption, high specific strengths [1]. Commercially available foams are increasingly used in applications ranging from ultra-light structural components in vehicles. Depending on the foaming technology, foams can either have closed-cell or open-cell microstructures. Some recently developed fabrication methods for porous metals result in more homogeneous pore structures for which cell sizes and cell topology can be controlled [2]. This leads to an even wider spectrum of mechanical properties of porous material which can be adjusted to the specific application. Such structures of porous material can be modelled using periodic models [3].

2. Periodic unit cell

The aim of this work is to develop numerical models of unit cell to predict mechanical properties of porous materials with different porosities. The numerical parameters which are needed to build the unit cell model are based on data obtained from microtomography images. For calculations, the finite element method program ABAQUS [4] was used to estimate the mechanical properties such as Young's modulus, Poisson's ratio and compressive strength.

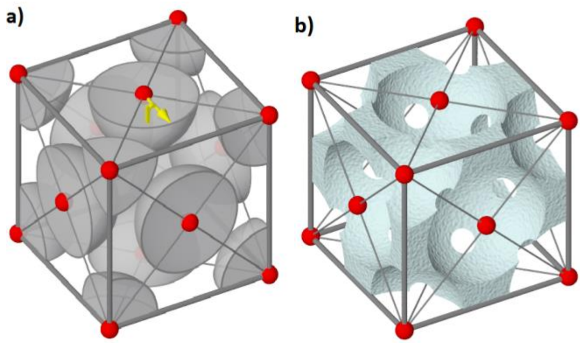

Fig. 1. (a) Arrangement of spherical bubbles in FCC crystallography system and (b) periodic unit cell obtained by the subtraction of the bubbles from the unit box.

Several numerical analyses have been performed to investigate structural dependency of unit cell on mechanical proprieties of porous materials. Three unit cell based on crystallography arrangement were considered: simple-cubic (SC), body-centered cubic (BCC) and face-centered cubic (FCC) which is presented in Fig.1. Depending on the radius of the bubbles, the unit cell can have closed-cell or open-cell microstructures.

The calculated results indicate that deformation and mechanical properties of newly developed unit cells can be used to study of deformation processes for a variety of porous materials e.g. metallic, ceramic and carbon foams. The obtained results of mechanical properties are very close to those from experiments.

2. References

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