Computational Homogenization for Determination of Material Properties of Closed Cell Foams

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Abstract: The foams are porous materials with open or closed cell structure. Metal foams, for example, are widely used in many industrial applications such as energy absorption structures, noise barrier structures, lightweight highly effective constructions and many other applications.

In the present talk, a 3D numerical homogenization strategy is proposed for determination of elastic material properties of closed cell foams. The performed homogenization procedure employs micro-computed tomography (micro-CT) and instrumented indentation testing data (IIT). The results from the micro-CT testing are used to determinate the following characteristics of the considered foam material – the volume fractions of the pores and the solid phases, the average size of the pores, the pore size distribution in a representative volume element (RVE). Using the micro-CT data, a 3D geometrical model of the closed--cell foam's RVE is created and this geometrical model is used to generate the respective finite element model. For simplicity, the pores are considered to have a spherical form as it is depicted in Fig. 1. In order to apply the homogenization technique, in the finite element model of the closed-cell foam's RVE, proper periodic boundary conditions are imposed. The obtained within the applied homogenization procedure six boundary value problems with periodic boundary conditions are solved using the finite element code ANSYS. The employed material model in the homogenization is the linear elastic model. The elastic properties of the solid phase are determined based on IIT data from testing of small volumes of the foam material. The determined elastic characteristics are analysed against data from literature in order to reveal the applicability of the used in this study homogenization procedure.

Figure 1. RVE with spherical pores.

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