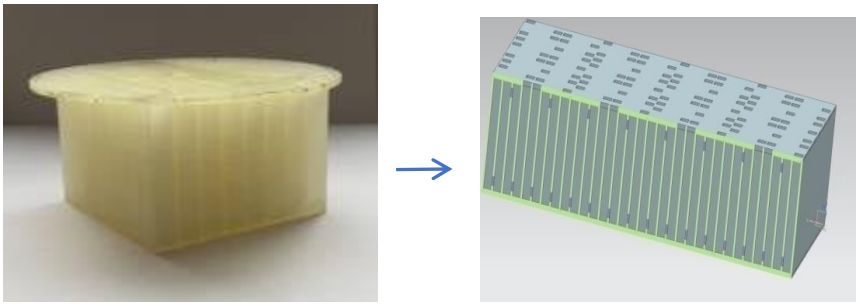
# NEW ACOUSTIC MATERIALS BY ADDITIVE TECHNOLOGY

*Tomilina T.M.*[1,a], *Afanasev K.M.*[1,2], *Vdovin R.A.*[1,2]

[1]A.A. Blagonravov Mechanical Engineering Research Institute (IMASH), Moscow, Russia
[2]Samara University named after S.P. Korolev, Samara, Russia
[a]tatiana@imash.ac.ru

The main goal of this paper is to demonstrate the advantages of additive technology in the development and fabricating of new acoustic materials with unique properties, so called acoustic metamaterials (AMM). Several samples of AMM absorbers (AMMA) with high sound absorption are presented. The samples in the form of cellular thin-walled periodic structures are synthesized by photopolymer material using the additive PolyJet technology. One AMMA model represents the cellular thin-walled internal structure with cells of the resonant type coupled by tubes with open end faces of 1 cm diameter. The geometrical parameters of one cell were chosen from a condition of obtaining high sound absorption in the frequency range, 300-600 Hz (the sizes of one cell is 50x50x50 mm and walls of 1 mm thick). Another basic AMMA structure chosen is a labyrinthine type structure composed of a number of compactly "coiled-up" resonators with various parameters. It is given in Figure 1.



a b

Figure 1. Labyrinthine cell-structure made by PolyJet technology:
a) the sample general view and b) its 3D digital cross-section

An essential feature of AMMA sample design are thin walls and complex space geometry with the horizontal elements, which require to use of supporting materials in the process of manufacture that complicates it, and the subsequent finishing processing. The task was to produce the desired structure without loss of quality. Two forms of additive manufacturing technology, the stereolithography (SLA) and the PolyJet 3D printing, were considered and the technical data of available printers LS 250 and Objet Eden 350 were compared.

The choice was made in favor of the PolyJet 3D printing and Objet Eden 350 printer, which has sufficient build platform and fabrication accuracy to create the 3D object with required parameters (based on the authors experience). To avoid possible distortion of the given form of the AMMA sample (e.g., effect of warping walls) additional experimental study has been conducted. For this purpose, several samples of thin plates were constructed by Objet Eden 350 printer. The optimum arrangement of the AMMA sample on a build platform was defined for the printed object to have no distortion.

The peculiarities of the synthesized process are studied and optimal parameters are found to provide the required shape of the samples. The results of experimental study of sound absorption efficiency of the synthesized samples are also presented that demonstrate twice higher sound absorption efficiency comparable with commonly used absorbers.

The work is supported by the Russian Science Foundation (grant no. 15-19-00284).