EFFECT OF HEAT LOSES ON THE STRUCTURE OF POROUS SHS MATERIALS*

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Self-propagating high temperature synthesis (SHS) is a promising method for manufacturing of porous gas permeable materials. The heat needed for sintering of a porous material is released during the chemical interaction of a mixture of the reactive components, i.e. a green mixture. The sizes of pores and skeleton elements of a synthesized material are significantly differing from the sizes of initial reagents, especially if the maximal temperature in the reaction zone exceed the melting point of any reactive component or a synthesis product. The reason is an existence of capillary effects in the SHS wave. Maznoy et al. [1] have studied the SHS of porous Ni-Al alloys and showed that skeleton elements are formed by up to 10^7 Ni and Al particles, which interacts in melted state during abrupt and superadiabatic temperature impulses.

There is an issue with SHS of coarse-porous materials, namely the formation of a skin-layer with small pores near the outer perimeter of a synthesized material. The skin-layer with small pore channels is dramatically reducing the permeability coefficient of a coarse-porous material. The formation of the skin-layer is favored because of heat loses of reactive media into the walls of a shape-generating molding tool, typically made from a steel or alloys with high thermal conductivity. The heat loses leads to abrupt decrease in temperature of the reactive mixture which significantly hinder the capillary effects, namely Marangony convection. The motivation of this work is a development of an approach for the obtaining of coarse-porous alloys without a small-pores skin-layer. The main approach is an applying of a barrier layer between the green mixture and the wall of a molding tool.

The experiments were conducted on a model SHS-system of Ni+15wt.%Al with the additives of 2 wt.% $Ca(OH)_2$ and 1 wt.% CaF_2. The green mixture was placed in a cylindrical molding tool made of stainless steel with inner diameter of 32 mm, wall thickness 3 mm, height 60 mm. The SHS was performed in the argon atmosphere with the initial preheating of 320 °C. The following barrier layers were analyzed: office paper, chalk-coated paper, slurry-based coatings of ZrO_2 fine powder and ash-microspheres.

The experimental results as follows: the thicker the barrier layer, the coarser the porous structure of the alloy skin-layer (figure 1).

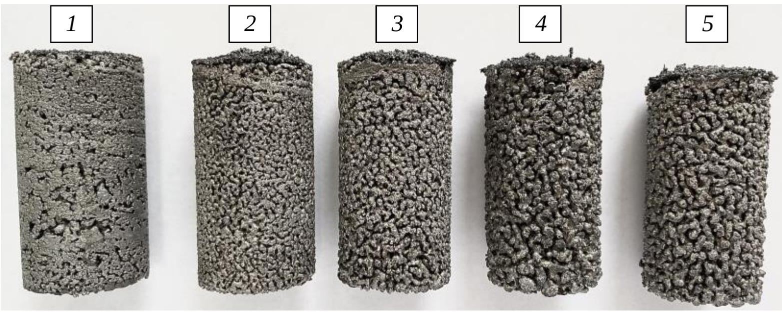

Figure 1. Images of synthesized alloys depending of the thickness of a barrier layer *h* made from the office paper. Part 1 – without barrier layer. Part 2 – *h* = 108 micron, Part 3 – *h* = 216 micron, Part 4 – *h* = 324 micron, Part 5 – *h* = 432 micron.

In the oral presentation the influence of different barrier layers on porous structure and SHS parameters will be presented quantitatively.

REFERENCES

1. A. Maznoy, A. Kirdyashkin, V. Kitler, N. Pichugin, V. Salamatov, and K. Tcoi, “Self-propagating high-temperature synthesis of macroporous B2+$L1_2$ Ni-Al intermetallics used in cylindrical radiant burners,” *J. Alloys Compd.*, vol. 792, pp. 561–573, 2019.

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