11th International Conference
on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Synthesis of Al/$MoSi_2$ Cermet Foams under the Activated Combustion Mode

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Abstract – There were synthesized Al/$MoSi_2$ cermet foams under the activated combustion mode. Influence of metal and activator amount on combustion and phase formation laws were investigated. It was shown that it is possible effectively synthesize cermet foams with 70% porosity and 5-45 % metal content in one macroscopic stage utilizing activated combustion approach.

Highly porous materials or foams are widely used as constructional and functional materials due to their peculiar mechanical, thermal, acoustic and other properties. Combination of these properties with low densities makes foams as promising materials for many modern applications. Among the artificial foams ceramic foams are widely applied in many fields of engineering.

In the work synthesis possibility of foam-like $MoSi_2$-Al cermet was explored utilizing self-propagating high-temperature synthesis (SHS) method.

In order to *in situ* "blow up" the product and form foam-like $MoSi_2$ it is necessary to provide for release certain volume of gases during the process. For this purpose some gasifying compounds were introduced into the initial mixture. These compounds must satisfy some requirements among them are: i) certain decomposition temperature within the desired interval, ii) decomposing without formation of secondary, undesirable solid components. NH_4F, NH_4Cl, as well as some CH polymers, etc may work as a gasifying compound. However in this case the released gases lead not only to the formation of a foam-like material, but also may cause a combustion limit (because of endothermic decomposition and higher heat loss). The latter can hamper the obtaining of foam. To avoid this fact "active" organic compound, such as polytetraflourethylene (Teflon) was chosen as blowing agent. Teflon acts not only as gas generating compound but also play the role of chemical and thermal activator. Thus, at decomposition of Teflon a large amount of gases are released. Moreover, these gases may react exothermically with initial reagents. This fact allows generating desired amount of gases during combustion without decreasing the combustion temperature.

It was investigated the influence of active additive on combustion and foam formation laws. The results obtained confirm that maximum porosity and homogeneity of the target product can be obtained when content of foaming agents no more than 5%. In the optimal case, up to 70% maximum porosity can be achieved for $MoSi_2$.

In order to get $MoSi_2$-Al cermet, various amount of aluminum powder was added into the initial mixture. The results obtained verify that it is possible to synthesize $MoSi_2$-Al cermet containing up to 45 wt% Al. The cermet obtained has lower porosity but higher toughness in comparison to foam-like $MoSi_2$. This allows obtain homogeneous metal matrix composite (ceramic foam with metallic matrix) in on macroscopic stage.