C3-P-002602

SYNTHESIS OF CERAMICS BASED ON SPINELS IN ELECTRIC ARC PLASMA*

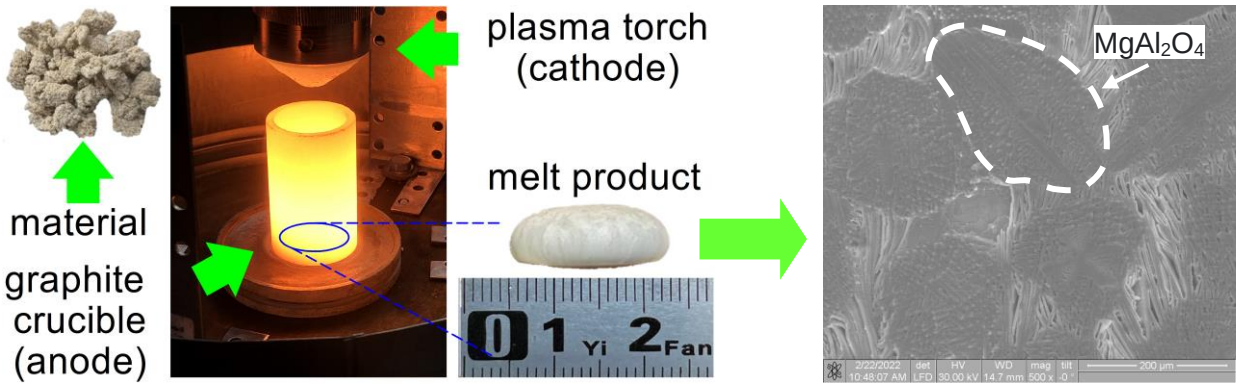
V.V. SHEKHOVTSOV, N.K. SKRIPNIKOVA

Tomsk State University of Architecture and Building, TSUAB, Tomsk, Russia

This paper presents the results of an experimental evaluation of the use of thermal plasma energy for the synthesis of ceramic samples based on spinels. Electric arc plasma torch was used as source of thermal energy, which made it possible to realize the complete synthesis of homogeneous melting products in terms of chemical composition. Analysis of the microstructure and phase composition was carried out to identify the key factors influencing the processes formation the microstructure of ceramics by the plasma melting method.

The following materials were chosen as the starting material for the synthesis of spinel-based ceramic samples: boehmite γ-AlO(OH), quartz sand β-SiO_2, magnesite $MgCO_3$. The component composition of the prepared charge corresponded to 30/10/60 wt. %. The prepared mixture was granulated to a fraction of agglomerates of 3–5 mm. An aqueous solution of sodium silicate Na2O(SiO_2)n with a concentration of 8% was used as a binder. The melting of the prepared samples was carried out on an experimental stand, including: electric arc plasma torch with remote discharge, nozzle diameter 5 mm; graphite crucible *h*=55, *d*=35, δ=3 mm; source of power CUT 160. The operating parameters of the plasma torch during the experiments corresponded to: current strength 100 A; voltage 120 V, thermal efficiency 87%, plasma gas flow rate 15 nl/min, exposure time 30 s.

Fig. 1, *a* shows diagram of the experimental stand. Fig. 1, *b* electronic images of the surface obtained melt product.



a *b*

Fig. 1. *a* – scheme of the process synthesis of ceramic samples based on spinels;
b – electronic image of the sample surface x500

As can be observed (fig. 1, *b*) the surface morphology of the synthesized spinel-based ceramic sample is represented by clear separation of grains by connected fibers. The shape of the grains is close to oval, and the structure has dendritic structure. According to the XRD results, the products are characterized by crystalline phase $MgAl_2O_4$. The main intensity of the diffraction peaks is at 2θ = 36.8, 44.8, 65.2°; no other impurities were found. Obviously, the grains are the centers of $MgAl_2O_4$ nucleation. Thus, in the work of showing the possibility of using electric arc plasma in the synthesis of ceramic samples based on spinels based on natural materials.

REFERENCES

[1] Nguyen M., Sokolář R., "Corrosion Resistance of Novel Fly Ash–Based Forsterite–Spinel Refractory Ceramics," Materials, vol. 15, no. 4, 1363, 2022.

[2] Pappas J.M., Dong X., "Comparative study of filament-fed and blown powder-based laser additive manufacturing for transparent magnesium aluminate spinel ceramics," Journal of Laser Applications, vol. 33, no. 4, 042037, 2021.

[3] Volokitin O.G., Shekhovtsov V.V., "Prospects of Application of Low-Temperature Plasma in Construction and Architecture," Glass Physics and Chemistry, vol. 44, no. (3), pp. 251-253, 2018.

[4] Volokitin O.G., Shekhovtsov V.V., Maslov E.A., "Plasma treatment technology for silicate melt used in mineral fiber production," Advanced Materials Research, vol. 880, pp. 233-236, 2014.

* The work was carried out with the support of the state task of the Ministry of Science and Higher Education of the Russian Federation FEMN-2020-0004 and grant President of the Russian Federation MK-66.2022.4.