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Заключение

В работе была показана возможность получения ультрадисперсного порошка нитрида алюминия плазмодинамическим методом в системе, основанной на использовании КМПУ. Установлено, что процентное содержание кристаллической фазы AlN в конечном продукте составляет около 50 %, а частицы, характерные для данной фазы, в полученном порошке имеют гексагональное строение и средние размеры от 100 до 150 нм. В дальнейшем планируется оптимизировать режимные параметры процесса синтеза и, тем самым, повысить выход нитрида алюминия одновременно с уменьшением количества примесных фаз.

Список литературы

1. Slack G. A., Tanzilli R. A., Pohl R. O., Vandersande J. W. The intrinsic thermal conductivity of AIN // Journal of Physics and Chemistry of Solids. – 1987. – № 48. – P. 641−647.
2. L.M. Sheppard, Aluminum nitride: a versatile but challenging material, Am. Ceram. Bull. 69 (11) (1990) 1801–1803.
3. Пат. 137443 РФ. МПК7 H05H 11/00. Коаксиальный магнитоплазменный ускоритель / А.А Сивков, А.С. Сайгаш, Ю.Л. Колганова. Заявлено 24.09.2013; Опубл. 10.02.2014, Бюл. № 4. – 6 с.
4. Pak A. Y., Sivkov A. A., Shanenkov I. I., Rakhmatullin I. A., Shatrova K. N. Synthesis of ultrafine cubic tungsten carbide in a discharge plasma jet // International Journal of Refractory Metals and Hard Materials. – 2015 – Vol. 48. – p. 51-55.
5. Shanenkov I. I., Sivkov A. A., Pak A. Y., Kolganova Y. L. Effect of Gaseous Medium Pressure on Plasmadynamic Synthesis Product in the C-N System with Melamine // Advanced Materials Research. - 2014 - Vol. 1040. - p. 813-818.
6. Sivkov A. A., Pak A. Y., Shanenkov I. I., Kolganova Y. L., Prosvirin I. V. Effect of Energy on Plasmodynamic Synthesis Product in the Carbon- Nitrogen System // Advanced Materials Research. - 2014 - №. 880. - p. 36-41.

NICKEL CONTAINING NANOPOWDERS AS HIGHLY DISPERSED PIGMENTS FOR CERAMIC DYES

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НИКЕЛЬСОДЕРЖАЩИЕ НАНОПОРОШКИ В КАЧЕСТВЕ ВЫСОКОДИСПЕРСНЫХ ПИГМЕНТОВ ДЛЯ КЕРАМИЧЕСКИХ КРАСОК

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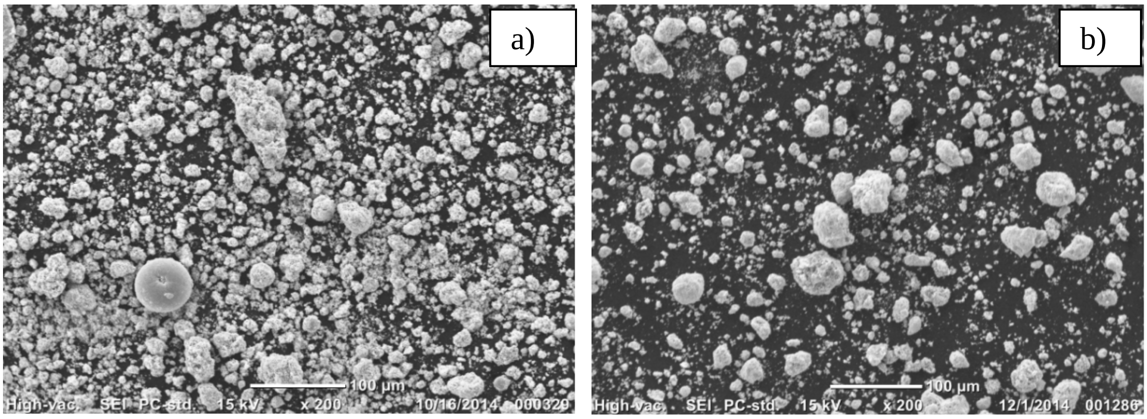
Аннотация. *В данной работе рассмотрены нанопорошков никеля и нихрома, полученные методом электрического взрыва проводника. Сравнены микрофотографии данных образцов, их энергодисперсионные спектры, по которым сделан вывод о составе данных порошков и размере ча-*

стиц. После смешивания данных порошков с бессвинцовой фриттой в различных соотношениях и обжига в различных средах были проанализированы цветовые характеристики и равномерность окраски полученных образцов.

Introduction. The prospective of using highly dispersed metal nanopowders as raw materials for ceramics production was already desribed in some scientific papers [1,2], although no investigation concerning the application of metallic nanopowders obtained via electric explosion of the conductor had been carried out because of the lack of studies carried out for this kind of material. In the current work the properties of metal nanopowders have been studied in case of their interaction with silicon glass-like materials. A comparable analysis of the products' properties has been made for the samples obtained via calcination in vacuum and open air.

While studying SEM pictures of Ni nanopowder with scaling in 200-300 times, it is possible to see the agglomerates of different shape and size. With more scaling up to 5500 times, the flocculent condition of the particles becomes obvious, that shows their tendency to agglomeration. While scaling the pictures up to 25000 times it has been shown that the size of some nanoparticles was less than 100 nm.



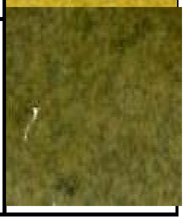
Picture 1 - SEM a) Ni b) NiCr

The energy-dispersive analysis had been used for determination of the element mass ratio in the nanopowder. For Ni nanopowder these numbers were described as follows: 85,26 % Ni 14,74% Ni_2O_3. XRD analysis also showed pure Ni and Ni_2O_3 in the structure of the nanopowder.

The agglomerates in NiCr nanopowder are bigger than in Ni nanopowder. The average size of those equals is less than 100 nm, also the spherical shape of NiCr particles has been determined. The XRD has shown pure Cr, Ni and Ni_2O_3 in the structure of the nanomaterial. ZAF Method Standardless Quantitative Analysis determined element ratio, which is the following: O – 10,57%, Cr – 20,38 %, Ni – 69, 06 %.

While studying the interaction between the silicon melt and the nanopowders, the last ones were mixed with the frit in 5:95 ratio, molded by pessing into the tablets and calcinated at the temperature 940^{o}C. The calcination speed was about 135^{o}C/h. After reaching the target temperature, nanomaterial was to stay at 940^{o}C for 2 minutes. During the calcination the both samples were melted.

Table 1 - The results of firing

Cipher and conditions of firing	The composition of the glaze	Character color	Firing temperature	λ, nm	A sample of the painted surface
C16,vacuum	NiCr 5% + lead-free frit	Dark-grey RGB 30.8-43.3-25.9	920	551	
H9,vacuum	Ni 5% + lead-free frit	Grey RGB 31.9-38.2-29.9	920	561	
HB9,air	Ni 5% + lead-free frit	Brownish yellow RGB-44,7-39,5-15,8	940	586	
CB16,air	NiCr 5% + lead-free frit	Greyish brown RGB-44,4-43,8-11,8	940	580	

Conclusion. These samples depending on a type calcination had various coloring. For example, the tablets calcinated in an open air had more light and level dyeing of sand and swamp color. The dyeing of the material calcinated in vacuum was grey with black point inclusions. Thus we can conclude that this temperature (920 ° C) of calcination in vacuum promotes preservation of a part of powder, which looks like metal creating unusual shades of dyeing.

References

1. François Henry, Jacques Bouillard, PhilippeMarchal, Alexis Vignes, Olivier Dufaud, Laurent Perrin. Exploring a new method to study the agglomeration of powders: Application to nanopowders Powder Technology 250 (2013) 13–20
2. Khabas T.A. Nanoporoshki metallov v tehnologii keramiki: uchebnoe posobie/ T.A. Khabas; Tomskii politehnicheskii universitet. – 2-e izd. – Tomsk: Izd-vo Tomskogo politehnicheskogo universisteta, 2009. – 230 s.