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NASA TECHNICAL MEMORANDUM

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# BURDEN FOR MANUFACTURE OF CERAMIC MATERIAL

T. V. Chechenya and Ye. A. Osipova


Translation of "Shikhta dlya izgotovleniya keramicheskogo materiala", USSR Patent No, 655691, Opisaniye Izobreteniya k Avtorskomu Svidetel'stvu, (Description of an Invention with Author's Certificate), Published in Bulletin Izobreteniy, No. 13, May 5, 1979, 2 pp.

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16. Abstract

The invention refers to ceramic materials which can be obtained by methods of powder metallurgy and can be used in high temperature technology.

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# BURDEN FOR MANUFACTURE OF CERAMIC MATERIAL

T. V. Chechenya and Ye. A. Osipova

The invention refers to ceramic materials which can be obtained /1* by methods of powder metallurgy and can be used in high temperature technology.

There are widely known ceramic materials, refractory masses which are used in high temperature technology [1].

The closest to the invention is burden for the manufacture of ceramic material which contains silicon carbide, chrome aluminophosphate binding agent, magnesium oxide and chromite. It contains the indicated ingredients in the following quantities, percent by weight: silicon carbide 55 - 63, chrome aluminophosphate binding agent 13 - 17; chromite of fraction less than 0.1 mm 20 - 25; magnesium oxide 3 - 5 [2].

The material has the following physical characteristics: volumetric weight 2.4 g/cm$^3$; ultimate compression strength (roasting temperature 1600°C) 6.00 - 7.00 kg/ mm$^2$; gas permeability 0.6 - 0.8 l.m./m$^2$ hour x wat.col.

The shortcomings of this material are high temperature of sintering and low mechanical strength. This excludes it from being used as structural material (for example, material for heat exchanger frames in gas-turbine engines).

The purpose of the invention is to improve the mechanical strength of the material.

*Numbers in margin indicate pagination in original text.

In order to achieve this goal, the burden for manufacture of the ceramic material which includes silicon carbide, magnesium oxide and aluminum chrome-phosphate binding agent, also contains silicon nitride with the following ratios of components, percent by weight:

| | |
|---|---|
| Silicon carbide | 32.9 - 47.3 |
| Magnesium oxide | 1.3 - 1.5 |
| Aluminum chrome-phosphate binding agent | 16.4 - 19.7 |
| Silicon nitride | 31.5 - 49.4 |

The raw material used was: green silicon carbide, silicon nitride, roasted magnesium, chrome aluminum phosphate binding agent. /2

The method of making the material consists of preparing a mass consisting of powder of silicon carbide and chrome aluminum phosphate binding agent to which silicon nitride powder and roasted magnesium are then added. All are carefully mixed and directly before molding, the mass is prepared.

It is molded in steel molds which are chrome-plated on the working surfaces with specific molding pressure of 300 - 1000 kg/cm$^2$.

The intermediate products are sintered according to the following technology:

Drying from 20° to 150°C for 5 hours in air.

Sintering from 20 to 700°C for 6 hours and holding at 700°C for one-two hours in air.

The effect of the percentage content of silicon nitride on the strength of the samples is indicated in the table.

| № CPB | SiC | MgO | $Si_3N_4$ | Density, g/cm$^3$ | $\sigma_{man}$ kg/mm$^2$ | $\sigma_c$ kg/mm$^2$ |
|---|---|---|---|---|---|---|
| 1 | [illegible] | 1,3 | 31,5 | 2,35 | 4,45 | 8,24 |
| 1 | [illegible] | 1,4 | [illegible] | 2,35 | 7,10 | 8,95 |
| 1 | [illegible] | 1,5 | 49,4 | 2,31 | 8,10 | 13,26 |

As is apparent, the magnitude of strength exceeds the same magnitudes of the known ceramic material ( 6 - 7 kg/mm$^2$ - $\sigma_c$). The items made of the proposed material, in addition, have low sintering temperature (700°C instead of 1600°C for the known ceramic material). The technology for manufacturing the items is comparatively simple and the employed materials are inexpensive. The volumetric weight of the material is about 2.4 g/cm$^3$, thermal stability is 1000 - 20°C of 20 air thermal cycling without destruction.

The proposed ceramic material can be used as structural high-temperature material, for example for heat exchanger frames of a gas-turbine engine.

Formula of the Invention

The burden for making the ceramic material which includes silicon carbide, magnesium oxide and aluminum chrome-phosphate binding agent is distinguished by the fact that in order to improve mechanical strength, it additionally contains silicon nitride with the following component ratio, percent by weight:

| | |
|---|---|
| Silicon carbide | 32.9 - 47.3 |
| Magnesium oxide | 1.3 - 1.5 |
| Aluminum chrome-phosphate binding agent | 16.4 - 19.7 |
| Silicon nitride | 31.5 - 49.4 |

Sources of information considered in the expert evaluation.

1. USSR Certificate of Authorship No. 348634, k. C 22 c 29/00, 1971.

2. USSR Certificate of Authorship No. 408935, kl. C 04 v 35/56, 1972.