Cordierite ceramics with improved performance properties

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Cordierite ceramics have found wide application in various fields of science and technology. Its distinctive feature is a low coefficient of linear expansion. Due to this property, cordierite ceramics perfectly withstands sudden temperature changes and is a heat-resistant material. The temperature limit for the use of cordierite products does not exceed 1300-1450 ° C during long-term operation. However, it is almost impossible to obtain ceramics with zero porosity.

In the course of the study, various raw materials were studied to obtain the maximum amount of cordierite in accordance with the above reactions. The work also investigated the effect of different amounts of glass bonds in order to obtain ceramics with minimal porosity.

Basic reactions to obtain cordierite

1) $2(3MgO{\cdot}4SiO_2) + \gamma\text{-}Al_2O_3 + 5(Al_2O_3{\cdot}2SiO_2) \rightarrow 3(2MgO{\cdot}2Al_2O_3{\cdot}5SiO_2)$

2) $2(3MgO{\cdot}4SiO_2{\cdot}2H_2O) + 6(Al_2O_3{\cdot}2SiO_2{\cdot}2H_2O) \rightarrow$
$3(2MgO \cdot 2Al_2O_3 \cdot 5SiO_2) + 5SiO_2 + 16\ H_2O$

3) $2(3MgO \cdot 4SiO_2{\cdot}2H_2O) + 6\gamma\text{-}Al_2O_3 + 7SiO_2 \rightarrow$
$3(2MgO \cdot 2Al_2O_3 \cdot 5SiO_2) + 4H_2O$

4) $2(3MgO \cdot 4SiO_2) + 6\gamma\text{-}Al_2O_3 + 7SiO_2 \rightarrow 3(2MgO \cdot 2Al_2O_3 \cdot 5SiO_2)$

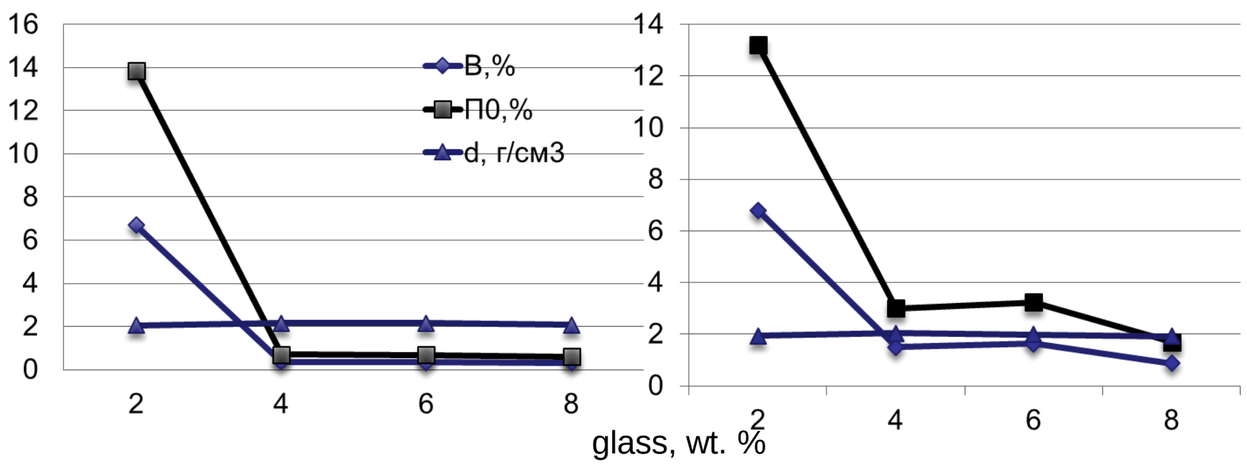
5) $2MgO + 2\gamma\text{-}Al_2O_3 + 5SiO_2 \rightarrow 2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$

6) $2(3MgO \cdot 4SiO_2 \cdot 2H_2O) + 6(Al_2O_3 \cdot 2SiO_2) \rightarrow$
$3(2MgO \cdot 2Al_2O_3 \cdot 5SiO_2) + 5SiO_2 + 4H_2O$

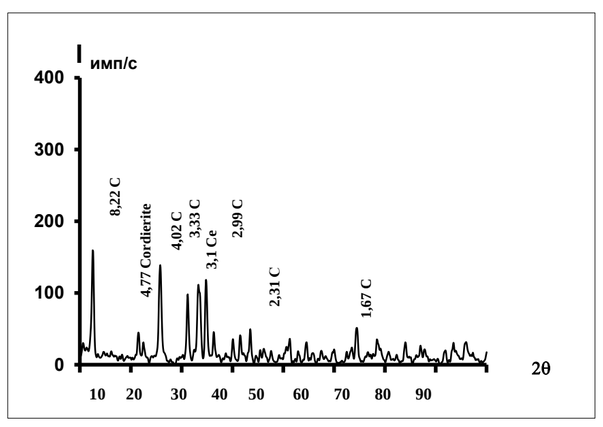
Influence of glass additive 30BaO · 10B2O3 · 60SiO2 on the properties of cordierite ceramics

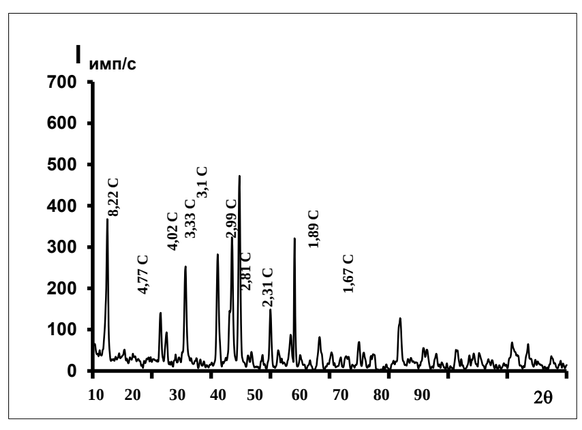
1- on the basis of cordierite fireclay

2 - without prior production of cordierite



X-ray phase analysis of material

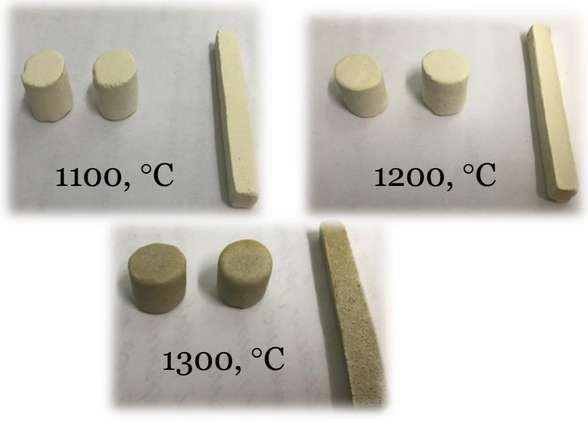




The composition of the experimental mixture

Raw	wt. %
Cordierit	90
Tialite	10
100% floor: Glass	6
$\alpha\text{-}Al_2O_3$	2

Samples of cordierite ceramics with the addition of tialite

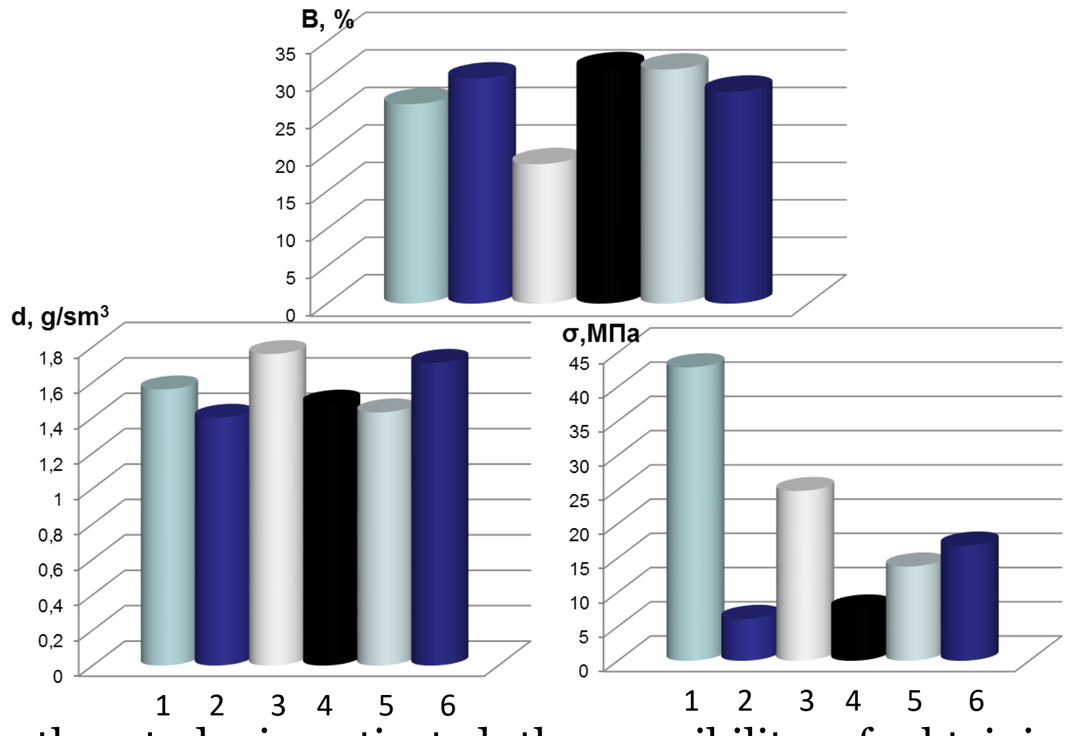


Properties of experimental ceramic samples

№	Firing temperature, °C	B,%	$П_0$,%	d, г/см 3	σ,МПа	$\alpha{\cdot}10^7$ 1/град$^{-1}$
1	1100	21,8	35,8	1,64	39,0	40,5
2	1200	11,7	21,2	1,80	72,0	16,8
3	1300	0,3	1,4	2,07	130,0	19,2

Properties of the developed cordierite ceramics

(Firing temperature, 1250°C)



Therefore, the study investigated the possibility of obtaining cordierite ceramics with improved performance characteristics. As a result of the development of the initial chemical composition of the base composition, it was possible to obtain materials with the following properties: porosity 1,4%, density 2.07 g/cm^3, compressive strength 130 MPa, temperature coefficient of linear expansion $19{,}2{\cdot}10^{-7}$ deg^{-1}.