SJIF Impact Factor 2021: 8.013| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 6 | Issue: 10 | October 2021 - Peer Reviewed Journal

EFFECT OF CRYSTALLIZER CATALYST ON PROPERTIES OF GLASS-CRYSTALLINE MATERIALS

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ABSTRACT

It was shown that the properties of the glass-crystalline material are much higher than those of the material obtained by conventional technologies. Therefore, it can be argued that on the basis of pyroxene glass synthesized on BSP with the addition of chromium oxide (no more than 3 wt%), it is possible to mass-produce abrasive-resistant yarn-guiding and yarn-guiding products for alkaline and spinning machines of textile enterprises.

KEYWORDS: *glass-crystalline material, solar furnace, glass phase, wear resistance;*

INTRODUCTION

One of the important tasks of creating glass-crystalline materials is to identify the optimal conditions for the technology of obtaining mono mineral glass-crystalline materials with a dropsied structure based on basalt rocks.

Thus, the properties of the glass-crystalline material are related to the properties of the amorphous phase. In other words, the carrier of the properties of the glass-crystalline material is the glass phase located in the inter granular region. This microstructure determines a peculiar combination of mechanical, dielectric and other properties of the glass-crystalline material.

METHODS AND MATERIALS

The Melting was carried out on a big solar furnace in a concentrated light flux in the flux range of 100 - 300 W/sм^2. Glass melting technology included the following stages: crushing, grinding of raw materials - mixture preparation - pressing - melting - hardening. TiO_2, CaF_2, P_2O_5 are used as crystallization catalysts, as well as heavy metal sulfides, which dissolve in the glass mass and form crystallization centers [1-7].

The technology of sintering of glass-ceramic materials synthesized on Large Solar Oven consisted of the following stages.

Wet grinding of glasses in a ball mill. Drying at 4000C. Molding. Firing in a resistance furnace in an air atmosphere for 4-6 hours in the temperature range 900 - 1150^{0}C (pyroxene materials) and 1300^{0}C (barium titanate) with arbitrary cooling in the furnace.

We used chromium oxide Cr_2O_3 (3 wt%) as a catalyst: 1) basalt without catalyst, composition I; 2) basalt (90%) + dolomite (10%) + chromium oxide (2 - 3%), composition II.

RESULTS

Please Figure 1 shows micrographs of stall samples of various compositions.

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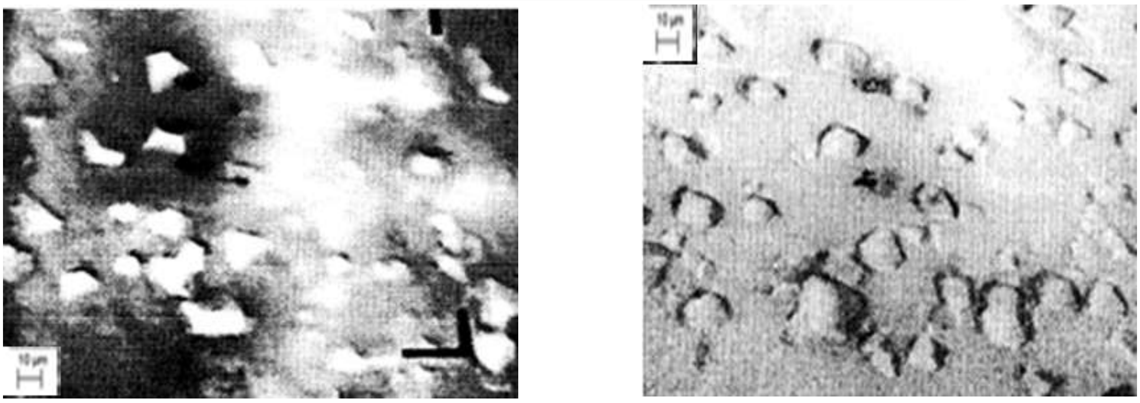

Composition I **Composition II**

Fig. 1. High-resolution EM images of pyroxene SC materials: I - original without additives; II - basalt (90%) + dolomite (10%) + chromium oxide (3%)

Composition I is characterized by the presence of polyhedrons of various sizes and shapes, distributed randomly over the volume of the glass-crystalline material. There is a glass phase interlayer between the grains. The material of composition II is characterized by the presence of slightly oriented polyhedrons of grains and a densely packed region with dimensions of 70 - 500 nm. This shows that additionally added chromium oxide stimulates the formation of a fine-grained structure, which improves powder sintering. glass-crystalline material obtained by directional crystallization contains 5 wt% glass phase and has a brown tint. The density of the stall material without a catalyst is on average 2.75 g/sm^3

In fig. 2 shows the dependence of the abrasion of the glass-crystalline material of the pyroxene composition on the amount of added (over 100%) chromium oxide.

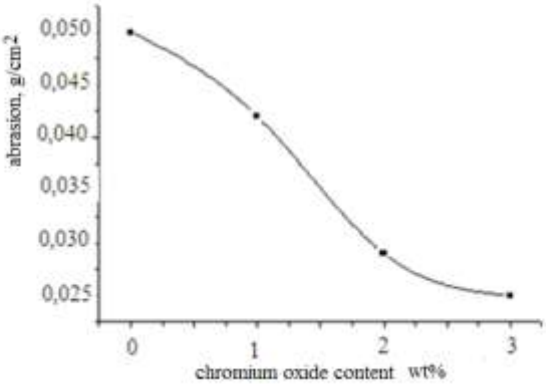

Fig. 2. Dependence of the abrasion of the glass-crystalline material of the pyroxene composition on the amount of added (over 100%) chromium oxide.

Figure 2 shows that the wear resistance of glass-crystalline material obtained by sintering fused basalt rocks with the addition of chromium oxide increases with an increase in the proportion of chromium oxide.

Chromium oxide acts as a catalyst for the crystallization of the main phase of dropsied – hedenbergite Ca Mg ($FeOFe_2O_3Cr_2O_3$) Si_2O_6-x

The presence of chromium oxide stimulates an increase in the adhesion of adjacent grains and thereby increases the wear resistance of the glass-crystalline material.

Table 1 shows some parameters of the pyroxene material with the addition of chromium oxide.

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Table 1 Properties of samples of glass-crystalline materials of different composition.

Properties	The amount of introduced Cr_2O_3, wt %			
	0	2,0	2,5	**3,0**
P_{mak}, MPa	125	135	150	**155**
density, g/sм^3	2,75	2,85	2,85	**2,85**
abrasion, g/sм^2	0,045	0,043	0,040	**0,040**
Thermal expansion coefficient , $1/^0C$	**$1{,}7x10^{-6}$**	**$1{,}6x10^{-6}$**	**$1{,}3x10^{-6}$**	**$1{,}1x10^{-6}$**

It can be seen that with an increase in the amount of Cr_2O_3, the ultimate strength increases, and abrasion decreases. These results indicate that chromium ions under the action of high-density of Cr_2O_3 transforms into Cr_3O_4 (CrO Cr_2O_3) due to a change in the valence of a part of chromium ions from Cr^{+3} to Cr^{+2}. Chromium ions participate in the formation of spinels of the type (Mg, Cr, Fe) (Cr, Al, $Fe)_2O_4$ at the grain boundaries, which contribute to the growth of the crystallization ability of glasses.

CONCLUSION

The use of chromium oxide as a catalyst leads to an increase in the wear resistance of the glass-crystalline materials. When exposed to high density of Cr_2O_3 transforms into Cr_3O_4 (CrO Cr2O3) due to a change in the valence of a part of chromium ions from Cr^{+3} to Cr^{+2}. Chromium ions participate in the formation of spinels of the type (Mg, Cr, Fe) (Cr, Al, Fe) $_2O_4$ at the grain boundaries, which contribute to the growth of the crystallization ability of glasses.

Consequently, the properties of the glass-crystalline material are much higher than those of the material obtained by conventional technologies. Therefore, it can be argued that on the basis of pyroxene glass synthesized on BSP with the addition of chromium oxide (no more than 3 wt%), it is possible to mass-produce abrasive-resistant yarn-guiding and yarn-guiding products for alkaline and spinning machines of textile enterprises.

Acknowledgments

The work was carried out within the framework of the research program of the Material Sciences Institute.

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