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Doped boro-lead-phosphate glass and nanocarbon composites and method for obtaining them

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Autori: Bogdan Alexandru SAVA, Lucica BOROICA, Ana Violeta FILIP, Ileana Cristina VASILIU, Mihail ELISA, Ana Maria IORDACHE

Abstract: The invention relates to the production of doped boro-lead-phosphate glass - nanocarbon composites, which have increased chemical homogeneity, while maintaining the other nanocarbon-induced properties, namely electrical and mechanical properties, and dopants add new optical and magnetic properties, amplified by phosphorus oxide in the vitreous matrix.

Introduction:

The articles and the patent on the same subject relate to composites for optical fibers or laser fibers, obtained by different methods (CVD, sintering, resin casting, powder and colloidal processing, melt mixing) by which they obtained either different layers of graphene / graphene oxide / nanocarbon on other materials, or sintered composites or mixed fibers, all having the disadvantage of a homogeneity of low composites, due to both the method used and the glass compositions introduced.

The technical problem solved by the invention consists in obtaining doped boron-lead-phosphate glass composites - nanocarbon, which have increased chemical homogeneity, while maintaining the other nanocarbon-induced properties, namely electrical and mechanical properties, and dopants add optical properties and new magnetic, amplified by phosphorus oxide in the glass matrix.

The novelty of the invention consists in the fact that new composites with optical and laser uses have been obtained, combining the properties of lead-borate glasses with the advantages and novelty of introducing phosphorus oxide and nanocarbon directly into the melt. The addition of nanocarbon directly to the melt ensures the homogeneity of the new electrical and mechanical properties introduced by the nanocarbon into the composite. Dopants, rare earth oxides, provide high optical and magnetic properties to these composites, which have the advantages of combining these properties with chemical homogeneity and nanocarbon-induced electrical and mechanical properties.

Materials:

Table 1. Molar percentage of glasses and composites

Molar percentage	0-50 (%)	10-30 (%)	40-70 (%)	5-15 (%)	2-20 (%)	3-15 (%)	3-20 (%)
Oxides	B_2O_3	P_2O_5	PbO	Li_2O	ZnO	Tb_2O_3, Dy_2O_3, CeO_2, Eu_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Gd_2O_3, Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3	graphene, graphene oxide or nanographite

Methods:

The composites, according to the invention, are obtained by a method for obtaining which consists in the wet preparation of the mixture of raw materials, with the addition of nano-carbon, ultrasonication, drying, heat treatment, pre-melting, melting at low temperatures, homogenization of the melt, casting, annealing and shaping of the homogeneous composite obtained.

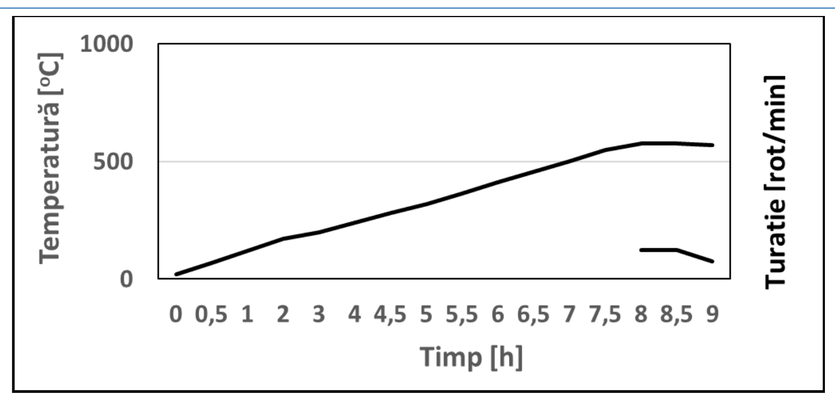

Figure 1. Pre-melting-melting-refining-homogenization program according to the invention, comprising temperatures, time frame, mixing regime, for BPPG3Ce composite.

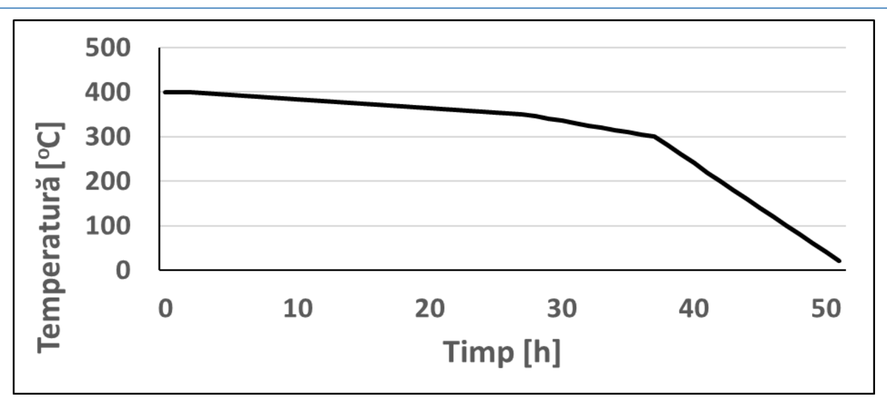

Figure 2. Annealing program for BPPG3Ce composite according to the process proposed in the invention, comprising the temperatures and time frame of the annealing process steps.

Conclusions:

Doped boron-lead-phosphate and nanocarbon glass composites have the advantage of superior chemical homogeneity, due to the method of obtaining, in conditions of preservation and more uniform distribution of nanocarbon-induced electrical and mechanical properties, and dopants add new, amplified optical and magnetic properties. of phosphorus and lead oxide in the vitreous matrix.

Bulk boron-lead-phosphate composites containing lithium and zinc oxide, doped with one or a pair of rare earth oxides, and nanocarbon, have the following improved characteristics: i) High homogeneity, in the whole volume of the composite; ii) Lack of defects such as inclusions or stones; iii) Small number of gaseous inclusions and their very small size; iv) lack of defects such as striations, threads, veins; v) Lack of stresses due to thermal gradients; vi) high chemical and thermal resistance; vii) superior electrical and mechanical properties; viii) Optical and magnetic properties comparable to the world level.

Doped boron-lead-phosphate and nanocarbon composites eliminate the disadvantages of previous work in that:

- contain: three glass network formers: B_2O_3, P_2O_5, PbO; vitreous network modifiers: Li_2O, ZnO; oxides that induce optical and magnetic properties: Tb_2O_3, Dy_2O_3, CeO_2, Eu_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Gd_2O_3, Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3; together with 3...20% molar nanocarbon of graphene type, graphene oxide or nanographite
- the process of obtaining this type of composite is new.

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