



POLITECNICO DI TORINO
Repository ISTITUZIONALE

Fabrication and characterization of new phosphate glasses and glass-ceramics suitable for drawing optical and biophotonic fibers

Original

Fabrication and characterization of new phosphate glasses and glass-ceramics suitable for drawing optical and biophotonic fibers / Lopez-Iscoa, P.; Ojha, N.; Pugliese, D.; Gumenyuk, R.; Massera, J.; Boetti, N. G.; Janner, D.; Boussard-Pledel, C.; Milanese, D.; Petit, L.. - ELETTRONICO. - (2019). ((Intervento presentato al convegno 2019 Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, CLEO/Europe-EQEC 2019 tenutosi a deu nel 23-27 Giugno 2019 [10.1109/CLEOE-EQEC.2019.8873064].

Availability:

This version is available at: 11583/2767632 since: 2020-12-29T22:19:29Z

Publisher:

Institute of Electrical and Electronics Engineers Inc.

Published

DOI:10.1109/CLEOE-EQEC.2019.8873064

Terms of use:

openAccess

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

IEEE postprint/Author's Accepted Manuscript

©2019 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collecting works, for resale or lists, or reuse of any copyrighted component of this work in other works.

(Article begins on next page)

Fabrication and characterization of new phosphate glasses and glass-ceramics suitable for drawing optical and biophotonic fibers

Pablo Lopez-Iscoa¹, Nirajan Ojha², Diego Pugliese¹, Regina Gumenyuk², Jonathan Massera³, Nadia Giovanna Boetti⁴, Davide Janner¹, Catherine Boussard-Plédel⁵, Daniel Milanese^{1,6}, Laetitia Petit²

¹Politecnico di Torino, Dipartimento di Scienza Applicata e Tecnologia, Corso Duca degli Abruzzi 24, 10129, Torino, Italy

²Photonics Laboratory, Tampere University, Korkeakoulunkatu 3, 33720 Tampere, Finland

³Faculty of Biomedical Science and Engineering and BioMediTech Institute, Tampere University of Technology, Korkeakoulunkatu 3, 33720 Tampere, Finland

⁴Fondazione LINKS – Leading Innovation & Knowledge for Society, Via P. C. Boggio 61, 10138 Torino, Italy

⁵University of Rennes, Ecole Nationale Supérieure de Chimie de Rennes, CNRS, ISCR –UMR 6226, F-35000 Rennes, France

⁶IFN - CNR, CSMFO Laboratory, Via alla Cascata 56/C, 38123 Povo, Italy

Rare earth doped phosphate glasses are attractive materials for the engineering of photonic devices, due to their easy processing, good thermal stability, excellent optical properties and high rare-earth ions solubility [1]. Besides, phosphate glasses with a P_2O_5 content of 50 mol% have been shown to be suitable for fiber drawing. It is well known that if the rare-earth ions are located in crystalline phase of desired nature and structure, the spectroscopic properties of the glasses can be enhanced [2]. Therefore, efforts have been focused on the development of new glass-ceramics (GCS) obtained from the heat treatment of glasses, as these engineered materials possess some of the glass properties (large flexibility of composition and geometry) but also some advantages of the RE-doped single crystals (high absorption and emission as well as long lifetimes).

In this presentation, we will first discuss how new active phosphate glasses can be prepared with a bioactivity functionality and their composition tailored to enhance their spectroscopic properties. We will show that the heat treatment does not necessarily lead to the bulk precipitation of rare-earth doped crystals (see figure 1). Therefore, we will present a new route to prepare rare-earth doped crystals containing glasses using the direct doping method (schematic presented in Figure 2). We will review the main challenge with this novel route of preparing glasses, related to the survival and dispersion of the particles in the glasses.

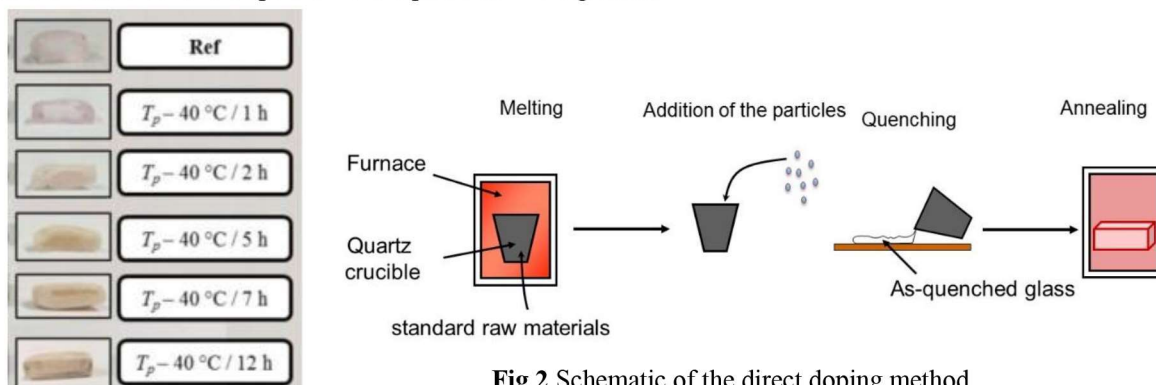


Fig. 1 Pictures of the phosphate glass within the $P_2O_5 - SrO - Na_2O$ glass system prior to and after different post-heat treatments.

Fig 2 Schematic of the direct doping method

Finally, we will demonstrate that some of the promising glasses can be drawn into optical fibers with broad luminescence over 70 nm of bandwidth and also into biophotonic fiber in the prospect of developing an innovative biosensor.

This work has been sponsored by the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 642557, Academy of Finland (Academy Projects-308558, 284492, 275427, 285170) and the support from Politecnico di Torino through the Interdepartmental Center PhotoNext.

References

- [1] S. Jiang, M. Myers, N. Peyghambarian, "Er³⁺ doped phosphate glasses and lasers", *J. Non-Cryst. Solids*, **239**, 143–148 (1998)
- [2] F. Auzel, D. Pecile, D. Morin, "Rare earth doped vitroceraamics: New, efficient, blue and green emitting materials for infrared upconversion", *J. Electrochem. Soc.* **122**, 101 (1975)