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

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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.

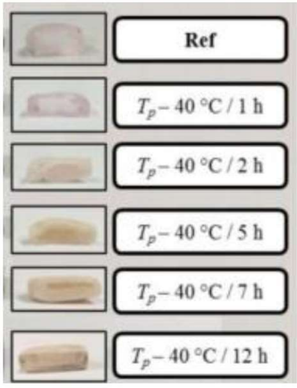

Fig. 1 Pictures of the phosphate glass within the $P_2O_5 - SrO - Na_2O$ glass system prior to and after different post-heat treatments.

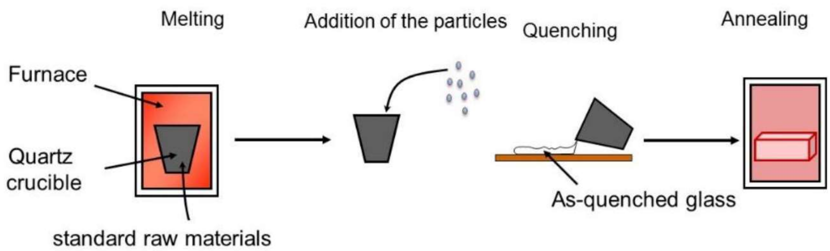

Fig 2 Schematic of the direct doping method

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.

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