Intermediate-Tg glasses for multi-materials fibers

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Abstract

Research on multimaterial multifunctional fibers flourished in the recent years, proposing an ever growing set of materials suitable for co-drawing as well as of fiber functionalities. So far however advances relied mostly on high-Tg silica-based materials (Tg $>$ 1000 ∘C) due to the technological interest of silica, and on low-Tg chalcogenide glasses (Tg $<$ 250 ∘C) that were deployed for integration in multimaterial glass/polymer/metal fibers.
Here we will review recent progresses in the feasibility of fabricating multimaterial fibers using glasses with intermediate Tg. The presentation focuses on phosphate glasses (Tg _˜350-450∘C) and on tellurite glasses (Tg _˜250-300∘C). Firstly, we report on the drawing of photosensitive silver-containing phosphate glass ribbon fibers. We demonstrate that luminescence properties of the native glass are preserved after shaping. Furthermore, we establish that the unique fiber's flat geometry allows for the direct, accurate Laser writing of complex luminescent silver clusters patterns and wave-guiding functionalities within the glass matrix.

Alternatively, we explore tellurite-based fibers. Here, bringing together the merits of these materials with fiber optic technology, we report on the direct drawing of tellurite-based core-clad dual-electrodes composite fibers. The rheological and optical properties of the selected glasses allow both to regulate the metallic melting flow and to manage the refractive index core/clad waveguide profile. We demonstrate the electrical continuity of the electrodes over meters of fiber. We believe the drawing of architectures merging electrical and optical features in a unique elongated wave-guiding structure will enable to develop new in-fiber sensing functionalities based on hybrid electric/optic nonlinear effects.
Great challenges lie ahead when it comes to mastering the implementation of intermediate-Tg oxide glasses within multimaterial fibers, but great opportunities lie ahead too, as it would give access to a whole new range of materials properties, and hence of functionalities, in linear/nonlinear optics, photonics, electro-optics or sensing.

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