

Glass and Glass-Ceramic Photonic Systems: advances and perspectives

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The development of optically confined structure is a major topic in both basic and applied physics not solely ICT oriented but also concerning lighting, laser, sensing, energy, environment, biological and medical sciences, and quantum optics. Glasses and glass-ceramics activated by rare earth ions are the bricks of such structures. Glass-ceramics are nanocomposite systems that exhibit specific morphologic, structural and spectroscopic properties allowing to develop new physical concepts, for instance the mechanism related to the transparency, as well as novel photonic devices based on the enhancement of the luminescence. The dependence of the final product on the specific parent glass and on the fabrication protocol still remain an important task of the research in material science. Looking to application, the enhanced spectroscopic properties typical of glass ceramic in respect to those of the amorphous structures constitute an important point for the development of integrated optics devices, including optical amplifiers, monolithic waveguide laser, novel sensors, coating of spherical microresonators, and up and down converters. This lecture presents some results obtained by our consortium regarding glass-based photonics systems. After a short history of research in glass ceramics we will comment the energy transfer mechanism in transparent glass ceramics taking as examples the up and down conversion systems and the role of SnO₂ nanocrystals as sensitizers. Coating of spherical resonators by glass ceramics, 1D-Photonic Crystals for luminescence enhancement, laser action and disordered 1-D photonic structures, polymeric-based structures for integrated optics, will be discussed. Finally, RF-Sputtered rare earth doped P₂O₅-SiO₂-Al₂O₃-Na₂O-Er₂O₃ planar waveguides, will be presented.

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