Development of highly-doped rare-earth phosphate glasses for NIR and SWIR fiber Laser sources

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Abstract

When compared to classical Laser systems, fiber Lasers are compact, robust devices allowing, due to their geometry, efficient thermal management and high-power generation. Because of the greatly advanced silica fibers fabrication process (purification, thermal drawing, etc...), most of fiber Laser developments were carried out on SiO2-based materials (technological improvement in pump, fiber design and fabrication techniques). Yet it appears that silica-based materials are not in many cases the most suitable candidates for the challenge that remain to be solved. Indeed, SiO2 glasses offer low solubility for most of luminescent materials such as rare-earth or transition ions and are also very prone to photo-darkening effects. For this reason, the development of new type of glass fibers for lasing applications is of primary importance. In this work, we report on the fabrication of highly-doped rare-earth phosphate glasses for fiber Lasers applications. Phosphate glasses possess the highest rare-earth ions solubility as well as good chemical durability, excellent optical properties, good fiber-shaping ability and high threshold versus photo-modification processes. As a first step, zinc-phosphate host matrices doped with Neodymium were explored. Investigations concerning the optimal Nd3+ ions concentration were carried out through emission luminescence and lifetime measurements of the manufactured glasses. Step-index fibers were then

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fabricated based on the developed glasses. Great efforts were put to reduce impurity as well as glass inhomogeneity-based optical losses. Different precursors and varying synthesis conditions were explored. Gain measurement were conducted. Finally the investigation was extended to Ytterbium and Erbium ions doping.

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