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In recent decades, multicomponent oxide glasses have demonstrated the capability to outperform silica glass as host material for emitters in the near-infrared (NIR) wavelength region. In particular, phosphate and germanate glass compositions can be doped with high amounts of rare earth ions (up to ten times more ions per unit volume with respect to silica) and thus allow the possibility of realizing compact optical amplifiers and fiber lasers able to minimize non-linear effects [1].
We report on the recent advances regarding Yb-Er co-doped phosphate glasses for power amplifiers and Tm-doped germanate glasses for NIR laser sources. Phosphate glasses offer an interesting platform for the realization of optical power amplifiers for ns pulsed sources at 1.5 μm wavelength, by using Er^{3+} ions as activators and Yb^{3+} ions as sensitizers. They have been properly engineered to be suitable for crystal-free fiber drawing and subsequently shaped into rods and optical fibers for testing as coherent sources for LIDAR systems.

Table 1: Yb-Er co-doped phosphate glass compositions for optical amplifiers. 2:1, 4:1 and 6:1 refer to the Yb^{3+}/Er^{3+} molar ratio.

Glass name	Er^{3+} [10^{20} ions/cm^3]	Yb^{3+} [10^{20} ions/cm^3]
YE 2:1	1.93	3.86
YE 4:1	1.92	7.69
YE 6:1	1.92	11.50

With the aim to develop new compact amplifiers operating in the 2um wavelength region, novel germanate glass compositions have been developed. Thermal analysis and preliminary fiber drawing test reveal suitable glass thermal stability against crystallization and good glass homogeneity towards the manufacture of performing fiber amplifier.

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References
[1] D. Milanese, J. Lousteau, X. Zhu, A. Chavez-Pirson, D. Pugliese, N. G. Boetti and N. Peyghambarian. Nonsilica Oxide Glass Fiber Laser Sources: Part I, Advances in Glass Science and Technology, Vincenzo M. Sglavo, IntechOpen (2018).