Titanium-doped sapphire is one of the most prominent laser materials and is appreciated for its excellent heat conductivity and broadband gain spectrum, allowing for a wide wavelength tunability and generation of ultrashort pulses. As one of the hardest materials, it can also serve as a model system for the fabrication of optical waveguide structures in dielectric crystalline materials and applications in integrated optics [1]. We review the recent approaches towards gain and laser operation in Ti:sapphire optical channel waveguides, including surface microstructuring and in-depth refractive-index modifications. Several methods including reactive ion etching [2,3], light-ion implantation [4], and femtosecond-laser irradiation [5] are presented and the results with respect to obtained refractive-index profiles, waveguide propagation losses, and laser performance [6,7] are discussed.

It has been recognized that the monoclinic double tungstates KY(WO₄)₂, KGd(WO₄)₂, and KLu(WO₄)₂ possess a high potential as rare-earth-ion-doped solid-state laser materials, partly due to the high absorption and emission cross-sections of rare-earth ions when doped into these materials [8]. Besides, their high refractive indices make these materials potentially suitable for applications which require optical gain and high power in integrated optics, with rather high integration density. We review our work toward the demonstration of waveguide lasers [9,10] and their integration with other optical structures on a chip [11].