Abstract

The master thesis is directed to investigate and find the robust solution to create an efficient source of tunable broadband mid-IR radiation through optical parametric amplification driven by Cr:Forsterite laser system. The available nonlinear crystals suitable for efficient wavelength conversion are considered in a comparative manner. Experimental study of several optical schemes supporting mid-IR pulse generation is also presented. In addition, specific regime of group velocity matching in KTA close to the crystal mid-IR transparency cutoff is found and experimentally demonstrated.

The master thesis also reports the design and construction of a highly efficient AGS based optical parametric amplifier. The highest efficiency of 3% was achieved around central wavelength 4 μm, which corresponds to 40 μJ output energy. The scheme offers more than 10% combined efficiency into the both signal and idler waves. The signal and idler pulses are tunable in the region 1.6 μm – 2.2 μm and 3.5 μm – 5.5 μm respectively with 150 fs pulse duration.

The achieved mid-IR pulse parameters makes the developed parametric source an ideal seeder for high power laser system based on Fe:ZnSe crystal. It also could be used as a driver for nonlinear optics experiments, in particular two-color dielectric modification and high harmonic and supercontinuum generation in bulk materials and dense gases.