Mid-infrared laser amplification of parametric seed in chalcogenide media with continuous wave pump

Annotation

The paper considers the possibility of creating a hybrid source of femtosecond mid-IR (3-7 μm) radiation at a high repetition rate (20 kHz - 1 MHz). Such a system consists of a difference frequency generation unit between two femtosecond oscillators of the near-IR range with subsequent amplification in active media based on chalcogenide crystals (Fe:ZnSe, Fe:CdSe). Pulses with an output power of the order of 1 mW in the wavelength range of 4 - 5 μm and around 6 μm were experimentally obtained during the difference frequency generation between Ti:sapphire/Yb oscillators and Yb/Cr:forsterite oscillators respectively. The possibility of the output power increasing was theoretically investigated by considering different nonlinear optical crystal with various lengths. The increase of the output power to 14 mW and 7 mW using a PPLN and LGS crystals at a wavelength of 4 and 6 μm was shown. The amplification properties of a Fe:ZnSe crystal continuously pumped by a 3 μm Er: ZBLAN laser were experimentally studied. Amplification of 2.5 is obtained, which corresponds to a gain of 1.06 cm^{-1}. Based on the obtained results, a multi-pass amplifier was calculated using the Frantz-Nodvik model.