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Short Communication

High Extraction Effiency, Nanosecond Bidirectional Ring Amplifier with Twin Pulses

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Abstract

Laser amplifier has been widely used in the field of scientific research, laboratory astrophysics and inertial confinement fusion (ICF), etc. The multi-pass amplifier (MA) is widely used in high-power laser systems such as ICF drivers, which requires expensive preamplifier systems to compensate for the limited gain of the main amplifiers. Besides, the laser system in MA should operate at high fluence to achieve high extraction efficiency, which results in a technical challenge in the damage of optical components under high-power lasers irradiation.

To efficiently extract the stored energy with low injection energy at low laser fluence operation and make the system compact, a bidirectional ring amplifier (BRA) with twin pulses is proposed. The characteristics of the bidirectional ring amplifier on energy flow, extraction efficiency and output energy capability are studied. The simulation results show that an extraction efficiency of 62.3% at the B integral limit can be obtained at low average fluence of 10.3 J/cm2 and the low injection energy of 3.9 mJ in the bidirectional ring amplifier. The output performance of the bidirectional ring amplifier with twin pulses is demonstrated. The injection energy of the twin pulses is 0.29 mJ and 0.32 mJ at the pulse width of 3 ns (FWHM), and the maximum output energy of the two pulses from BRA is 347 mJ and 351 mJ, respectively. Compared to the effective efficiency extraction of 32% in ring amplifier with single pulse, the maximum extraction efficiency of stored energy in BRA with twin pulses is 60% under the same operation condition. The bidirectional ring amplifier is more compact and the extraction efficiency is much higher at low laser fluence operation, which is beneficial to reduce the effects of nonlinear phase shift. Moreover, the preamplifier for BRA is simple, only a fiber oscillator and a regenerative amplifier can work.

Biography:

Xiao Yuan is a professor of School of Optoelectronic Science and Technology, Soochow University, China. He received the BA degree in physics and the PhD degree in optics from Sichuan University. From 1982 to 2002, he worked in Northwest Institute of Nuclear Technology, and was a professor at Huazhong University of Science and Technology from 2002 to 2009, China. He joined Soochow University in 2009, and his current research includes advanced lasers, micro- and nano-meter fabrication and laser interferometry, etc.