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Development of picosecond Yb:YAG amplifiers for OPCPA pumping

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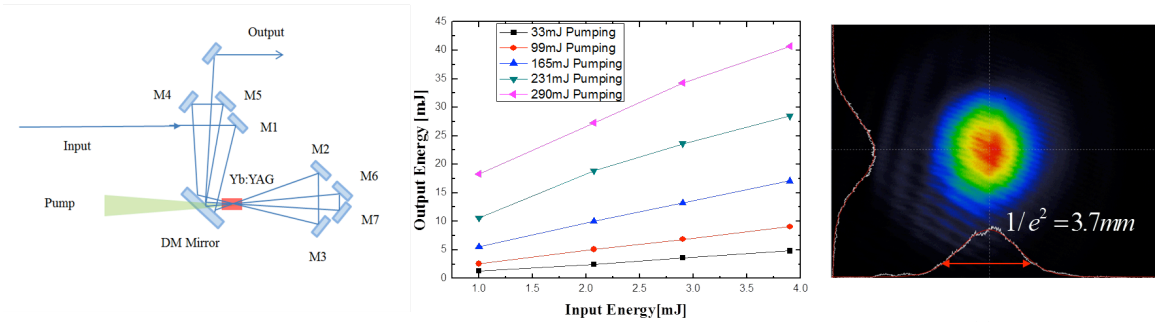
Nowadays, the high power lasers have been widely utilized for various applications such as material processing and high energy beam generation. It was advanced for development of high power laser technologies such as femtosecond oscillators, white light generation available of few-cycle pulse, and optical parametric amplification (OPA) capable of ultra-broadband amplification. Especially, optical parametric chirped pulse amplification (OPCPA) based on the combination of chirped pulse amplification and OPA enable to implement ultra-high peak power few-cycle lasers. Broadband amplification has been investigated with picosecond pulse source, thus it is highly required to develop the picosecond to sub-nanosecond pump source to realize the broadband amplification with high energy and high repetition rate [1-2]. Cryogenically cooled Yb:YAG system would be a good alternative to develop the picosecond pump source for OPCPA due to the advantage such as capability of low thermal load and long fluorescence lifetime compared to the Nd-doped materials [3-4] .In this paper, we report on the development of 4 pass amplifier with cryogenically cooled Yb:YAG system.

The optical layout of 4 pass amplifier with a “bow-tie” configuration is shown in Fig.2(a). Here, we used 10 ns seed pulses from a Yb:YAG regenerative amplifier as a preliminary test. Small signal gain was measured as 115 when 290 mJ pump energy was launched into the crystal. Amplified output energy with the input energy was shown in Fig.2(b). It is available to achieve 43 mJ pulse energy (excitation LD 290 mJ) when we use the 4.1 mJ input source. It also shows the Gaussian beam profile with $1/e^2$ diameter of 3.76 mm as shown in Fig.2 (c).



(a) (b) (c)

Fig.1. (a) Schematic diagram of 4-pass pre-amplifier, (b) the amplified output pulse energy with an input energy and (c) typical spatial beam profile of the amplified beam.

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