FOUR PASS DUAL CELL SBS-PCM AMPLIFIER

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Efficient methods for generating high-energy picosecond pulses with high beam quality are still a challenge, as conventional picosecond pulse generation methods have certain limitations. Q-switching prevents pulses shorter than ∼0,3 ns [1], while mode locking limits the pulse energy, to the order of μJ [2]. We have recently demonstrated energy-scalable an efficient self-seeded single-cell SBS configuration [3] to achieve the ultimate >10 times pulse compression of ∼1.1 ns pulses from a commercially available Nd:YAG mini-laser. The shortest pulse width of ∼93 ps at the output of the double-pass SBS-PCM Nd:YAG amplifier with an improved beam quality and reduced beam pointing fluctuations by a factor of 4 compared to a conventional MOPA was achieved [3]. The goal of this study was to further investigate and upgrade it to a four-pass self-seeded dual-cell SBS-PCM configuration (Fig. 1). Particular attention was also paid to ensuring a high-quality output beam, as well as the long and short-term stability of the laser.

In our experiment Nd:YAG passively Q-switched mini-laser operating at a repetition rate of 10 Hz was used as the source of initial pulses with a duration of 1.05 ns and an energy of ∼2 mJ at a wavelength of 1064 nm. After four-pass Nd:YAG amplifier without SBS-PCM, ∼20 mJ of pulse energy was achieved with a signal pulse energy of 270 μJ. However, taking into account the equations of Frantz-Novick maximum energy of ∼45 mJ can be achieved with a maximum seed energy of 2 mJ.

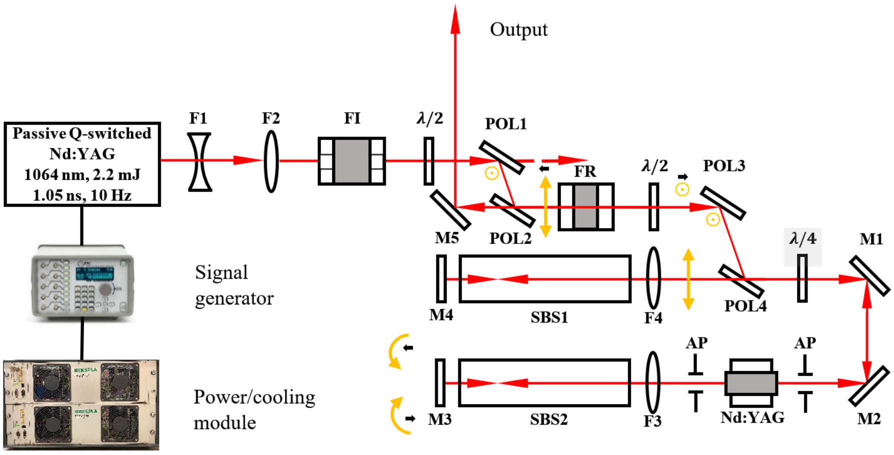

Fig. 1. Fig. 1. SBS-PCM amplifier scheme: F1, F2 – beam expanding telescope; FI – Faraday isolator; FR – Faraday rotator; $\lambda/2$ – half-wave retardation plate; $\lambda/4$ – quarter-wave retardation plate; POL1, POL2, POL3, POL4 – thin-film polarizers; Nd:YAG – amplification module; M1, M2, M5 – 45° plane mirrors; M3, M4 – 0° plane mirrors; AP – aperture; SBS1, SBS2 –SBS cells.

Also, two SBS cells were implemented into this four-pass amplifier configuration to compress the pulse width and improve the beam quality. This self-seeded four-pass SBS-PCM amplifier layout lets us expand the laser beam diameter up to ∼4 mm to avoid optical damage threshold and achieve up to ∼40 mJ output pulse energy with Sub-90 ps pulse width.

To conclude high output pulse energy laser based on SBS-PCM in sub-90 ps scale with good beam quality was developed. It can be applied in dermatology as tattoo removal, as it has a good beam quality that prevents scar formation. Finally, this laser system also a good candidate for high-throughput interference patterning of a metal surface to impart water-repellent properties.

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