Tapered fiber is a potential candidate for delivering high-energy, ultrafast lasers with high beam quality

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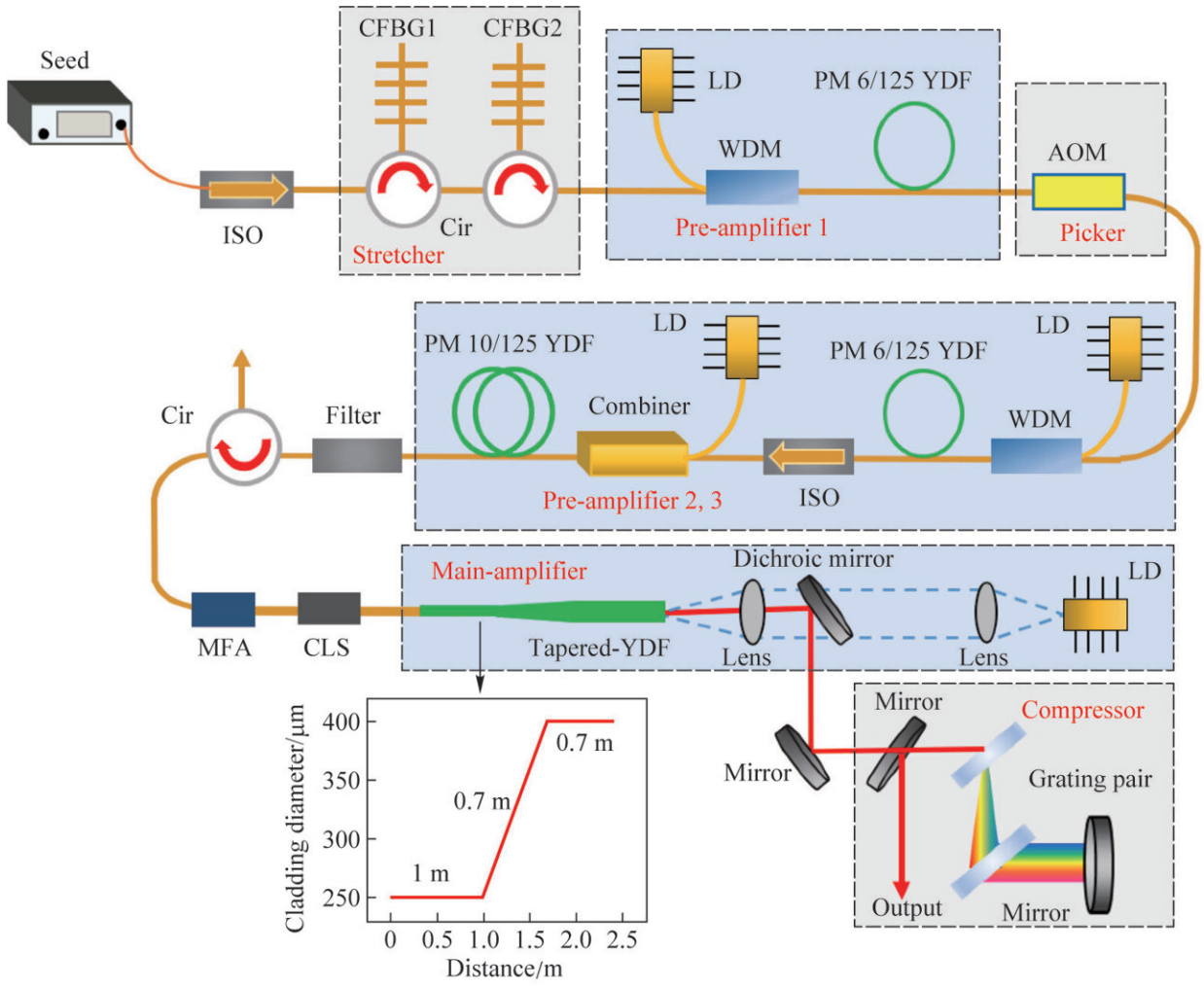

Credit: *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00087-y

Ultrafast lasers have the advantages of high time resolution, high energy density, broadband spectrum, etc. Ultrafast lasers with high-energy and high peak power have been widely applied in industrial fields and frontier science, such as advanced manufacturing, photomedicine, and ultrafast physics.

Researchers led by Prof. Pu Zhou and A./Prof. Can Li at National University of Defense Technology (NUDT), China, are interested in high power/energy ultrafast fiber laser technologies. Fiber lasers have the advantages of flexible and compact system, high conversion efficiency, as well as excellent beam quality.

Limited by the small mode field area and the long transmission length, the pulse energy and peak power scaling of ultrafast fiber lasers are significantly hampered by unwanted nonlinear effects. In general, the threshold of nonlinear effects is proportional to the mode field diameter (MFD).

The fiber MFD cannot be arbitrarily increased to mitigate the nonlinear effects, however, as high-order mode (HOM) contents would emerge and deteriorate the output beam quality. The tapered fiber has a longitudinally increased core/cladding diameter, which has the potential to balance the nonlinear effects and the beam quality.

By combining a tapered confined-doped fiber and high-order dispersion compensation technique, the researchers have demonstrated a high-energy and high peak power monolithic CPA system with near diffraction-limited beam quality (M^2=1.20). The maximum pulse energy of 126.3 μJ was obtained after pulse compression with a pulse duration of 401 fs and a peak power of 207 MW, which represents the highest peak power generated from a monolithic fiber laser ever reported.

The work titled "Monolithic tapered Yb-doped fiber chirped pulse

amplifier delivering 126 μJ and 207 MW femtosecond laser with near diffraction-limited beam quality" was published in *Frontiers of Optoelectronics*.

More information: Tao Wang et al, Monolithic tapered Yb-doped fiber chirped pulse amplifier delivering 126 μJ and 207 MW femtosecond laser with near diffraction-limited beam quality, *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00087-y

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