Researchers fabricate co-doped aluminosilicate fiber with high laser stability for multi-kW level laser

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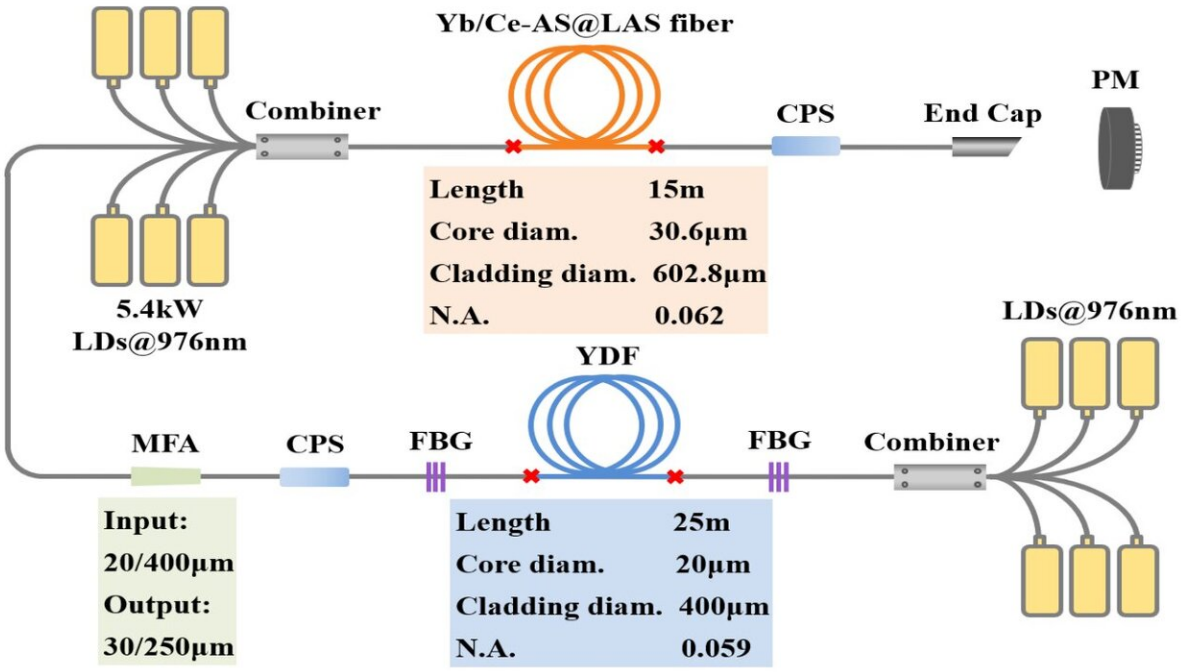

Schematic diagram of MOPA configuration. Credit: XIOPM

Multi-kilowatt (kW) (≥3kW) level fiber lasers with high stability are significant in many applications, and Yb-doped fiber is the key device in such fiber lasers. The incredible advances of the past few decades in fiber fabrication technology have led to an exponential increase in the

output power of continuous-wave (CW) fiber lasers. However, with further scaling the output power, photodarkening (PD) was found to be one of the critical limit factors for long-term laser reliability under multi kW level output power.

PD effect is manifested as an evolution process of pump-induced excess loss depending on pump power and dopant concentrations. It can be attributed to color centers that derive from the cooperative energy transfer process which is from excited Yb^{3+} to the atomic defect precursors in the fiber core. Co-doping Ce can strongly improve the PD resistance in Yb/Al co-doped fiber, despite the mechanism of PD resistance realized by co-doping Ce still has not been well understood yet.

SHE Shengfei, together with collaborators from the Xi'an Institute of Optics and Precision Mechanics (XIOPM) of the Chinese Academy of Sciences, fabricated a 30/600 active fiber with high laser stability, named as Yb/Ce-AS@LAS fiber by low-temperature chelate gas phase deposition (LT-CGPD) technique to synthetically evaluated Ce addition in multi-kW level Yb doped fiber. And finally, based on the Ce co-doped Yb/Al fiber, they demonstrated an excellent result at 1,079.80 nm. The works were published in the Journal of Lightwave Technology.

The researchers fabricated serial co-doped Yb/Al fibers with gradient Ce concentration and proved that the Ce addition can effectively improve the PD resistance of the fiber.

With the master oscillator power amplifier (MOPA) configuration, they successfully achieved the highest CW laser power of 5.04 kW output at 1079.80 nm with a slope efficiency of 81.1%. Simultaneously, the long-term stability of high-power fiber amplifiers was effectively improved at the same time, indicating the suppressing effects of Ce addition on PD and additional thermal load.

They didn't only break a fiber laser power record, but also paved a way towards better commercial high-power fiber lasers, based on the self-made Yb/Ce co-doped aluminosilicate fiber fabricated by LT-CGPD technique.

More information: Shengfei She et al. Yb/Ce Codoped Aluminosilicate Fiber With High Laser Stability for Multi-kW Level Laser, *Journal of Lightwave Technology* (2020). DOI: 10.1109/JLT.2020.3019740

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