US 20230231354A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0231354 A1**

**Hsia et al.** (43) **Pub. Date: Jul. 20, 2023**

(54) **ALL-FIBER LASER OSCILLATORS ADOPTING SIDE-PUMP SIGNAL-AND-PUMP COMBINERS**

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(21) Appl. No.: **17/892,906**

(22) Filed: **Aug. 22, 2022**

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 17/576,890, filed on Jan. 14, 2022, now Pat. No. 11,592,620.

**Publication Classification**

(51) **Int. Cl.**

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|---|---|
| ***H01S 3/067*** | (2006.01) |
| ***H01S 3/23*** | (2006.01) |
| ***H01S 3/094*** | (2006.01) |
| ***H01S 3/0941*** | (2006.01) |
| ***H01S 3/16*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***H01S 3/06733*** (2013.01); ***H01S 3/06716*** (2013.01); ***H01S 3/06737*** (2013.01); ***H01S 3/2308*** (2013.01); ***H01S 3/0675*** (2013.01); ***H01S 3/094019*** (2013.01); ***H01S 3/0941*** (2013.01); ***H01S 3/1618*** (2013.01); ***H01S 3/094053*** (2013.01)

(57) **ABSTRACT**

An all-fiber laser oscillator comprises a laser cavity, an amplification fiber, a plurality of diode lasers, and at least one side-pump signal-and-pump combiner (combiner). The combiner comprises a double-clad fiber (DCF) and four or more multimode fibers (MMFs). DCF comprises a first taper portion, whereas each of MMFs comprises a second taper portion fused around DCF. MMFs are configured to carry a portion of combined optical energy (COE) and to couple to DCF. The first taper portion can partially compensate a beam divergence created by the second taper portion, thereby increasing a coupling efficiency of COE coupled from MMFs to DCF with improved thermal performance. In a coupling portion, a refractive index difference between MMFs and DCF is configured to form a backward coupling barrier to suppress an optical energy in DCF from coupling into MMFs, thereby protecting the plurality of diode lasers from damage.