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STUB LASER

HOMOGENIZES LASER INTENSITY PROFILE

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“Stub Laser” Homogenizes Laser Intensity Profile

It is well known that the output beam characteristic of a multi-mode laser diode is inherently non-uniform due to both spatial and temporal variations of the mode profile [Figure 1] due to thermal lensing and filamentation [1]. These non-uniformities (hot-spots and/or dark-spots) can lead to deleterious effects for many applications including: solid-state laser pumping [2], Raman spectroscopy of sensitive materials [3], laser speckle contrast imaging [4], and laser illumination [5]. There have been many different methods utilized to homogenize the output power of a multi-mode laser beam, including the use of mode-mixing in long lengths of multimode optical fibers or custom multi-faceted homogenizers [2,5], refractive beam shapers [6], and orbital rastering [3]. However, many of these beam tailoring techniques are often complex, expensive or require large amounts of real estate.

The “stub laser” shown in Fig. 2, incorporates a TEC-cooled, Volume Bragg Grating (VBG) spectrum-stabilized, multimode laser diode in a compact footprint 14-pin butterfly package with a proprietary mode-mixing waveguide for beam homogenization [Figure 3]. Innovative Photonic Solution’s proprietary multimode wavelength-stabilized laser features high output power (> 300 mW) with narrow spectral bandwidth with a shaped and homogenized beam profile that evenly spreads out the power density and shapes the beam and to match the field of view of a camera or spectrometer slit with minimal decrease in coherence length [7]. Designed to replace expensive DFB, DBR, fiber, and external cavity lasers, the multi-mode spectrum stabilized laser offers superior wavelength stability over time, temperature (0.007 nm/°C), and vibration, and is manufactured to meet the most demanding wavelength requirements. Multi-mode laser diodes are available with narrowed spectral linewidth for FWHM < 0.1 nm (0.07 nm typical) upon request. Devices can be spectrally tailored (638 – 1064 nm) to suit application needs and offer side mode suppression ratios (SMSRs) better than 40 dB (70 dB at some wavelengths available with additional optional filter).

This “stub” laser diode package configuration has shown improved performance for many of the applications listed above. For Raman spectroscopy, the small footprint, high power, narrow laser line width, high signal to noise ratio, and output beam homogenization, make this an ideal source for robust commercial systems. For laser speckle contrast imaging [4], the narrow spectral linewidth, long coherence length, and output beam homogenization all contributed to a 50% increase in global spectral contrast.

[1] A. Zeghuzi et al., IEEE Jl. Selected Topics in Quantum Electron., **25**, 1502310 (2019).

[2] S. Seyedzamani and E. Eslami, Optical Engineering, **56(8)**, 085106 (2017).

[3] J. Arno et al., Proc. SPIE **9101**, 91010Q (2014).

[4] R. Chimenti, Laser Focus World, Nov 2020, 35 (2020).

[5] Y. Lutz and F. Christnacher, Proc SPIE **5087**, 185 (2003).

[6] A. Laskin et al., Proc. SPIE **8600**, 860010 (2013).

[7] Link to RPMC datasheet of stub laser

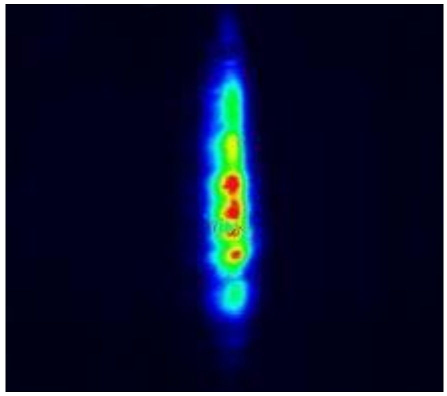

Figure 1 – Non-uniform far-field intensity profile of conventional multimode laser showing intensity “hot spots”

Figure 2 – Innovative Photonics Inc. proprietary “Stub laser”.

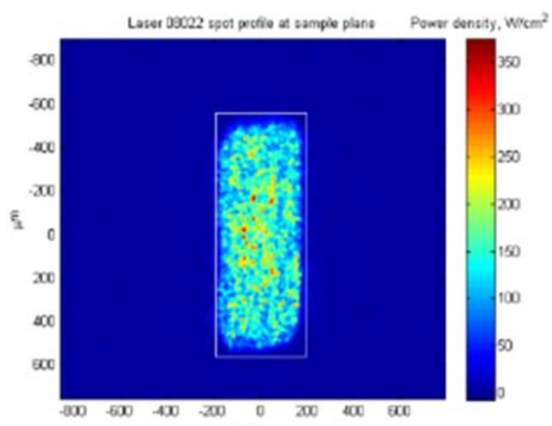

Figure 3 – Intensity profile of Innovative Photonics Inc. “Stub laser” utilizing proprietary mode-mixing waveguide.