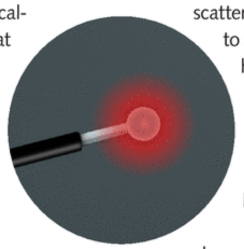
newsbreaks

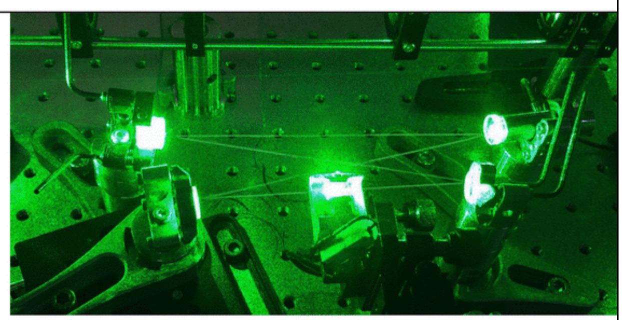
Shaped glass diffusers for medical use handle high laser powers

Phototherapy has come into its own as a tool for treating medical conditions, including treating cancers, psoriasis, enlarged leg veins, and so on. Localized light-based treatments that require high intensities benefit from laser light delivered through optical fiber. The remaining problem is how to deliver the light to the area being treated in a precise distributed manner while maintaining high efficiency and durability for clinical use. For this purpose, engineers at Schott (Mainz, Germany) have developed diffusers made of what Schott calls "glasslike materials" that produce a homogenous light output at high laser powers and can transmit visible, infrared, and ultraviolet wavelengths with high efficiency; the materials incorporate scattering elements to deliver up to 20 W of laser light with high efficiency (low absorption). The ability to handle high powers is critical because plastic components melt or could cause tissue burns if they overheat.



Mounted on optical-fiber ends, the diffusers are biocompatible and physically durable, although they are designed for single-use instruments that are discarded after use (as opposed to repeated-use instruments that are sterilized for reuse). Diffuser geometries include flat, cylindrical, and spherical, as well as custom; the cylindrical diffusers are typically 5 to 50 mm in length, diameters down to 100 μm, and an optical output of up to 500 mW/cm^2, while the spherical diffusers typically range from 0.3 to 1 mm in diameter and support optical powers of up to 20 W. The diffusers work at wavelengths ranging from the near-UV into the near-IR (NIR) at up to wavelengths of 2 μm. "Our next anticipated R&D steps are further improving transmission in the NIR/IR spectrum, as well as realizing challenging emission patterns," says Juergen Hammerschmidt, head of new business development at Schott Lighting and Imaging. *Contact Haike Frank at haike.frank@schott.com.*

Diamond Brillouin laser could generate millimeter-wave frequencies for radar



Researchers from Macquarie University (Macquarie Park, Australia) have discovered a novel and practical approach to Brillouin lasers (lasers that incorporate light/sound interaction for light amplification), in the form of diamond lasers that have an output power 10X higher than any other Brillouin laser. Diamond is a particularly interesting material for this type of laser: Its high thermal conductivity makes it possible to create miniature lasers that simultaneously have high stability and high power; in addition, the speed of sound in diamond (18 km/s) is also much higher than in other materials, giving the laser a secondary ability to directly synthesize frequencies in the hard-to-reach millimeter-wave band (30–300 GHz) via photomixing. Brillouin laser synthesis of these frequencies is important because there is an intrinsic mechanism that reduces the frequency noise to the levels needed by next-generation radar and wireless communication systems. This has been a major challenge for electronics or other photonic-based generation schemes.

The new laser, the first bench-top Brillouin laser that uses diamond, provides a practical approach to Brillouin lasers with an increased range of performance. In contrast to earlier Brillouin lasers, the diamond version operates without having to confine the optical or sound waves in a waveguide to enhance the interaction. As a result, these lasers can be more easily scaled in size and have greater flexibility for controlling the laser properties as well as increasing power. Only a very small amount of waste energy is deposited in the diamond sound-carrying material, which leads to features including beam generation with ultrapure and stable output frequency, the generation of new frequencies, and potentially, lasers with exceptionally high efficiency. The diamond Brillouin laser produces more than 10 W of optical power and demonstrated a synthesized 167 GHz from a 532 nm input. The authors next want to demonstrate lasers with the higher levels of frequency purity and power needed to support future progress in quantum science, wireless communications, and sensing. Other applications include ultrasensitive detection of gravitational waves and manipulating large arrays of qubits in quantum computers. *Reference: Z. Bai et al.*, APL Photonics*, 5, 031301 (2020); https://doi.org/10.1063/1.5134907.*