Abstract for an Invited Paper
for the MAR06 Meeting of
The American Physical Society

Prospects of Mid Infrared Silicon Raman Laser

BAHRAM JALALI, University of California Los Angeles

Mid wave infrared (MWIR) lasers in the wavelength range of 2-5μm form an important tool for free space communications, bio-chemical detection and certain medical applications. Most organic chemicals and biological agents have unique signatures in the MWIR and can be detected using these lasers. The strong water absorption peak at 2.9μm renders such a laser attractive for surgery and dentistry. Solid state lasers comprising OPO-based nonlinear frequency converters and Raman lasers have been the popular choice for these applications. However, the low damage threshold, poor thermal conductivity and high cost limit the commercial availability of these sources. The recent demonstration of the first silicon Raman laser in 2004 combined with excellent transmission of silicon in the mid-IR suggests that silicon should be considered as a MWIR Raman crystal. In the near IR, where current silicon Raman lasers operate, free carriers that are generated by two photon absorption (TPA) create severe losses. TPA vanishes in the MWIR regime ($\lambda > 2.25\mu$m), hence eliminating the main problem with silicon Raman lasers. This combined with (i) the unsurpassed quality of commercial silicon crystals, (ii) the low cost and wide availability of the material, (iii) extremely high optical damage threshold of 1-4 GW/cm2 (depending on the crystal resistivity), and (iv) excellent thermal conductivity renders silicon a very attractive Raman crystal. Moreover, integrated waveguide and resonator technologies can lead to device miniaturization. This talk discusses the MWIR silicon laser and its applications.