Chalcogenide Fiber Based Mid-IR Sources and Applications

L. Brandon Shaw¹, Rafael R. Gattass¹, Lynda Busse¹, Jesse Frantz¹, Daniel Gibson¹, Fred H. Kung², Rajesh Thapa³, and Jasbinder S. Sanghera¹

¹Naval Research Laboratory, Code 5620, Washington, DC 20375, USA
²University Research Foundation, Greenbelt, MD 20770, USA
³Sotera Defense Solutions, Crofton, MD 21115, USA

SUMMARY

In the visible and near-IR, silica fiber high power lasers, amplifiers, fiber combiners, couplers, fiber optic switches and attenuators have demonstrated impressive performance and have become critical technologies for many applications such as telecommunications, spectroscopy, sensing, laser machining, and directed energy. As mid-IR and long-wave IR applications become more prolific, the need for analogous devices in the IR becomes important. Chalcogenide fiber shows great promise for meeting the source and device needs for applications in the IR. Chalcogenide fiber has a broad transmission range out to 12 μm, depending upon composition, and is ideal for transmission of light in these wavelength ranges. In addition, chalcogenide fibers can be doped with rare earth ions or the high nonlinearity of chalcogenide glasses can be exploited to fabricate sources in the mid and long-wave-IR. In work to date, we have demonstrated an all-fiber broadband supercontinuum source in the mid-IR from 1.9 to 4.8 μm and have scaled up the power to >500 mW in this wavelength range [1]. We have also demonstrated a microchip laser pumped mid-IR supercontinuum source from 3.65 to 4.9 μm [2], IR fiber Raman amplification [3], and broadband mid-IR rare earth doped fiber sources [4]. Passive optical devices that we have demonstrated include chalcogenide fiber based optical attenuators [5], registered coherent imaging bundles [6] and multimode fiber combiners for power and wavelength combining of quantum cascade lasers [7]. In addition, we have developed methods to fabricate high power anti-reflection surface structures on chalcogenide fibers [8], splicing methods for chalcogenide fibers, and cabling and termination methods for fibers to allow the fiber sources and devices to be packaged for applications. Environmental testing and power testing has been performed on chalcogenide fiber and devices to determine the operational limits of these technologies. In this paper, we will review our prior and recent work on chalcogenide based mid-IR sources and devices and the packaging, characterization and applications of these sources and devices.

References


