SPECIALTY MICROSTRUCTURED FIBER-BASED ALL-FIBER DEVICES FOR APPLICATIONS IN THE MID-IR

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To leverage on the huge progress achieved in optical fiber communication, more recently a strong interest has emerged in the literature for application-specific specialty fiber designs. Microstructured fibers often referred to as photonic crystal fibers form a versatile design platform for such fibers. Because of the multitude of fiber parameters that one can play around, these fibers first developed in early 1990s, offer much more freedom in the design space as compared to a conventional fiber. So unlike conventional fibers, these fibers could be designed to yield a highly nonlinear fiber, a large/ultra-large mode area fiber, fibers with zero dispersion in the normal or anomalous dispersion regime, and so on. In view of such unusual features, these fibers are now widely used to generate broadband super continuum light via ultrafast femtosecond laser pumping, supercontinuum light find extensive use for example in biophotonics for optical coherence tomography, in frequency combs, and also in several other niche applications. In recent years mid-IR wavelength regime ($2 \sim 10$ μm) has attracted a lot of attention due to many potential applications in photonics. Some portions of this wavelength regime is also known as “molecular finger print” regime because of absorption by molecules like O_2, H_2O, CO, CO_2, NO, N_2O, OH, CH_4, HCL, etc with well resolvable transitions. In the defense, this wavelength regime is also attractive for high power delivery for applications like heat sinking missiles and counter measures, and thermal imaging in low power night vision in defense, etc. Other emerging potential applications include non-destructive soft tissue ablation in medical diagnostics, molecular absorption spectroscopy for monitoring combustion flow and gas dynamics.

In this presentation we would present our extensive recent work on several all-fiber device designs based on microstructured fibers assumed to be formed with well known chalcogenide and mid-IR materials. These include narrow and broadband all-fiber light sources through wavelength translation/parametric process of four wave mixing (FWM) in certain localized wavelength regimes of short (SWIR) - to mid-wavelength IR (MWIR) through wavelength translation exploiting commercially available lasers as pumps, large to ultra-large mode area fiber designs for large power throughput, and generation of parabolic pulses as well as supercontinuum light in the mid-IR wavelengths.

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