Integrated Tellurite Waveguide for Supercontinuum Lasers

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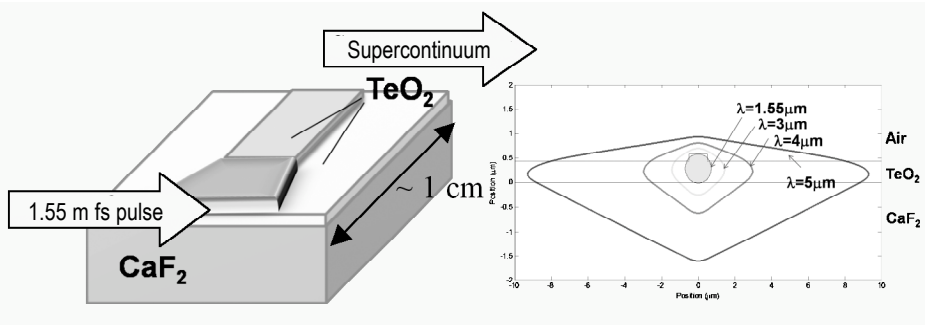

Schematic of the supercontinuum laser which incorporates an ultra-compact, integrated single-mode TeO_2 waveguide for the supercontinuum generation.

Supercontinuum (SC) generation is a nonlinear optical phenomenon in which an ultra-broadband yet coherent light is generated from a single wavelength, short pulsed laser source through a series of elastic and inelastic nonlinear optical effects. SC generation has been achieved in the visible, near-infrared, and mid-infrared wavelength ranges. The limit of the wavelength range is largely determined by the transmissivity of the nonlinear media. In this project, we aim at exploiting the large optical nonlinearity and highly transparent tellurite (TeO_2) material to extend the SC generation beyond the 5μm wavelength which is critical for many chemical sensing applications. For mid-infrared SC generation, a 1.55μm ultra-short pulse laser is seeded through the TeO_2 waveguide. The SC is generated via self-phase modulation, cross-phase modulation, self-focusing, stimulated Raman scattering, and etc. The major challenge is to obtain high amorphous quality TeO_2 waveguide to achieve the maximum transparency and nonlinearity. Our approach is to use the low-temperature radio-frequency sputtering technique followed by the room-temperature chemical etching process. This is to avoid the re-crystallization of TeO_2 which often occurs at the elevated temperature. Re-crystallized TeO_2 can lower the nonlinearity and the laser damage threshold. We have numerically designed the single-transverse mode TeO_2 waveguide for the SC generation and are currently working on the waveguide fabrication. This project is supported by the Omniscience and Defense Advanced Research Projects Agency.