CROSS-CORRELATION FROG CARS WITH FREQUENCY-CONVERTING MICROSTRUCTURE FIBERS

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Abstract: Microstructure fibers provide a high efficiency of frequency upconversion of regeneratively amplified femtosecond pulses of a Cr: forsterite laser. These pulses from a microstructure fiber used to measure the spectra of coherent anti-Stokes Raman scattering (CARS) of toluene molecules (XFROG CARS).

Microstructure (MS) fibers[1] offer attractive and practical recipes for the enhancement of nonlinear-optical interactions of ultrashort pulses.[2] Here we will show that these fibers are capable of generating ultrashort frequency-tunable pulses with a controlled chirp, which are ideally suited for nonlinear coherent spectroscopy. These fibers, in fact, combine the wavelength tunability, typical of OPAs, with the possibility to probe large spectral and delay-time ranges with a single pulse due to frequency--time mapping defined by chirped pulses. MS fibers, therefore, offer attractive cost-efficient solutions for coherent nonlinear spectroscopy, allowing the creation of novel compact sources of frequency-tunable chirped ultrashort pulses, supplementing in many ways currently available OPAs and dye laser sources. Subpicosecond anti-Stokes pulses with a linear positive chirp generated in a microstructure fiber were cross-correlated in our experiments with the femtosecond second-harmonic output of the Cr: forsterite laser in toluene solution, used as a test object, in boxcars geometry (Fig. 1) to measure the spectra of coherent anti-Stokes Raman scattering of toluene molecules. This experimental technique integrates CARS and cross-correlation frequency-resolved optical gating (XFROG CARS).

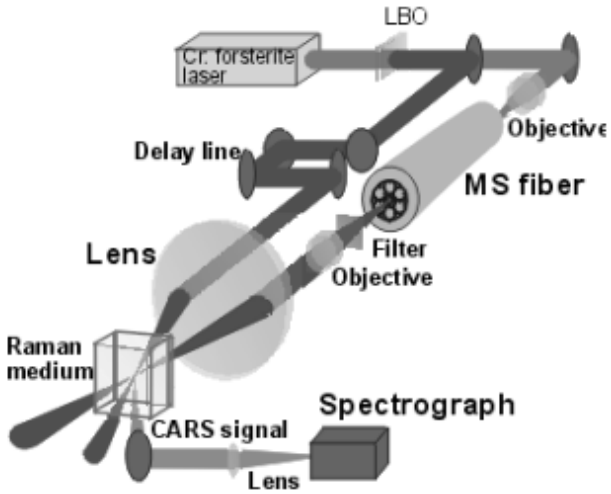

Fig. 1. *Diagram of femtosecond CARS spectroscopy with the use of ultrashort pulses frequency-upconverted and chirped in a microstructure fiber.*

References:

1. P.St.J. Russell, Science **299**, 358 (2003).
2. *Nonlinear Optics of Photonic Crystals*, Feature issue of J. Opt. Soc. Am. B **19**, no. 9 (2002), C.M. Bowden and A.M. Zheltikov, eds.