Generation of Intense Supercontinuum based on Multiple Plates of Fused Silica

Chih-Hsuan Lu[1], Yu-Chen Cheng[2], Hong-Yu Chen[1], Shang-Da Yang[1], Ming-Cheng Chen[1], Yuan-Yao Lin[1], Chia-Chen Hsu[3], and A.H. Kung[1,2]
[1]*Institute of Photonics Technologies, National Tsing Hua University, Hsinchu, Taiwan 30013*
[2]*Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan 10627*
[3]*Department of Physics, National Chung Cheng University, Chiayi, Taiwan 62102*
lzch2000@hotmail.com, akung@pub.iams.sinica.edu.tw

Abstracts: *An octave-spanning femtosecond supercontinuum is generated by highly nonlinear interaction in multiple plates of fused silica. Spectral interferometry of the multi-μJ continuum reveals excellent spectral and spatial coherence of the pulse.*

The generally accepted approach to the generation of an intense supercontinuum in the visible region is by passing an intense mJ-level femtosecond laser pulse through a small-core meter-long hollow fiber or a special (Kagome) fiber filled with a gas medium [1,2]. While a solid medium should also be useful in supercontinuum generation, the substantially lower damage threshold in solids coupled with high optical dispersion that limits the generated bandwidth had made solids unattractive for high power application [3]. Here we show that these shortcomings can be overcome such that for the first time a similarly broad and intense visible continuum can be generated. This is accomplished by strategically placing several thin solid (e.g. fused silica) plates to minimize the adverse effects at or near the focus of a focused femtosecond laser beam while allowing the spectral broadening to proceed [4].

In our experiment we focused a 25 fs, 243 μJ pulse to an intensity of 1.5×10^{13} W/cm^2 on a 100 μm thick fused silica plate to obtain the initial spectral broadening. A second plate of similar thickness was inserted at a distance downstream along the beam path just beyond the point where damage would occur to produce a cascaded spectral broadening effect. The insertion of crystal plate was repeated until the spectrum broadens no more. The result, as shown in figure 1(a), is a 134 μJ pulse with an octave-spanning continuous spectrum from 420 nm to 1000 nm (30 dB). The pulse has excellent spatial mode quality of M^2 of 1.1. Dispersed spectral interferometric measurements show good pulse coherence (Figure 1(b)). Details of the generation mechanism and results on compression of this multiple-plate generated continuum (MP Continuum) will be presented.

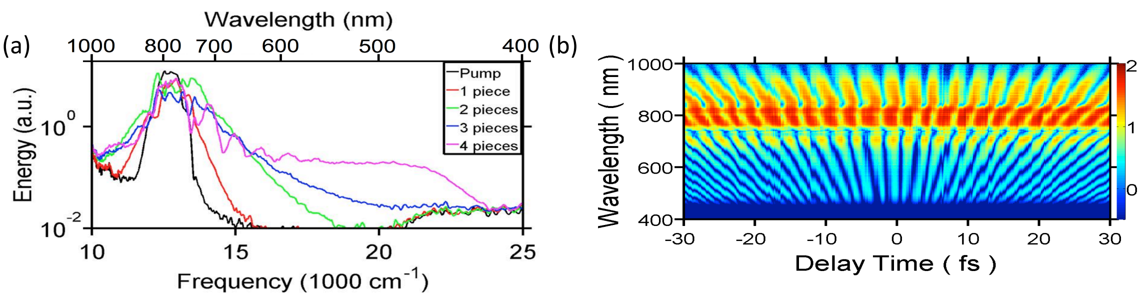

Figure 1. (a) Spectrum generated with different number of thin fused silica plates; (b) spectral-resolved interferometric diagram of the generated MP Continuum.

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