Opto-Electronic Advances

Supplementary information

2020, Vol. 3, No. 7

DOI: 10.29026/oea.2020.190033

10-GHz broadband optical frequency comb generation at 1550/1310 nm

Junyuan Han[1,2,4†], Yali Huang[3†], Jiliang Wu[1,2], Zhenrui Li[3], Yuede Yang[1,2], Jinlong Xiao[1,2], Daming Zhang[3], Guanshi Qin[3*] and Yongzhen Huang[1,2*]

[1]State Key Laboratory of Integrated Optoelectronics, Institute of Semiconductors, Chinese Academy of Sciences, Beijing 100083, China; [2]Center of Materials Science and Opto-Electronic Engineering, University of Chinese Academy of Sciences, Beijing 100049, China; [3]State Key Laboratory of Integrated Optoelectronics, College of Electronic Science & Engineering, Jilin University, Changchun 130012, China; [4]National Key Laboratory of Science and Technology on Electronic Test and Measurement, the 41st Research Institute, China Electronics Technology Group Corporation, Qingdao 266555, China.

*Correspondence: G S Qin, E-mail: qings@jlu.edu.cn; Y Z Huang, E-mail: yzhuang@semi.ac.cn

This file includes:

Section 1: The group velocity dispersion of the HNLF
Section 2: The evolutions waveforms in the silica HNLF
Section 3: Schematic diagrams of the experimental setup
Section 4: Complete optical spectra of the generated flat-topped OFC

Supplementary information for this paper is available at https://doi.org/10.29026/oea.2020.190033

Section 1: The group velocity dispersion of the HNLF

The group velocity dispersion (GVD) profiles of silica HNLFs are shown in Fig. S1. The GVDs are ~ 0.293 ps^2/km and ~ −0.5 ps^2/km at the wavelength of pump wave (1550 nm), respectively. In addition to dispersion, other performance parameters of silica fiber 1 and 2 are similar. The nonlinear coefficient is ~ 10.8 $(W{\cdot}km)^{-1}$ and fiber attenuation is ~0.2 dB/km for silica fiber 1 at 1550 nm. The nonlinear coefficient is ~ 10 $(W{\cdot}km)^{-1}$ and the fiber attenuation is ~ 0.762 dB/km for silica fiber 2 at 1550 nm.

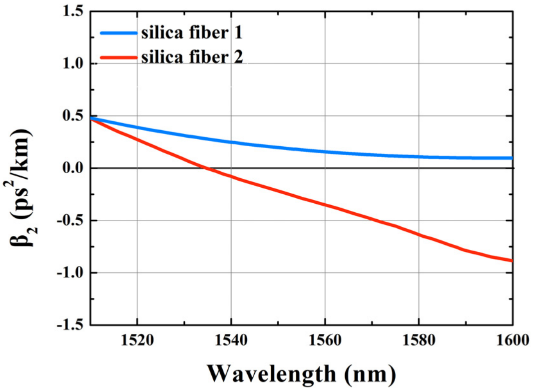

Fig. S1 | Group velocity dispersion profiles of the silica HNLFs.

Section 2: The evolutions waveforms in the silica HNLF

The optical time domain pulses obtained after pumping 500 m HNLF and 4 m SMF with different powers are shown in Fig. S2. In order to facilitate the output of HNLFs, a SMF with a length of about 1 m was fused at the end of HNLF. At the same time, it is necessary to connect an optical polarization controller to control the polarization of incident light before entering FROG, which is equivalent to adding a section of SMF. Due to these limitations, we cannot directly measure the true condition of the output pulses by the highly nonlinear fiber. After a large number of experiments, we found that Fig. 3(b) is the shortest pulse we can get, when the pump power is 20 dB and the length of the SMF is 4 m. Therefore, all test results are performed with 500 m HNLF and 4 m SMF.

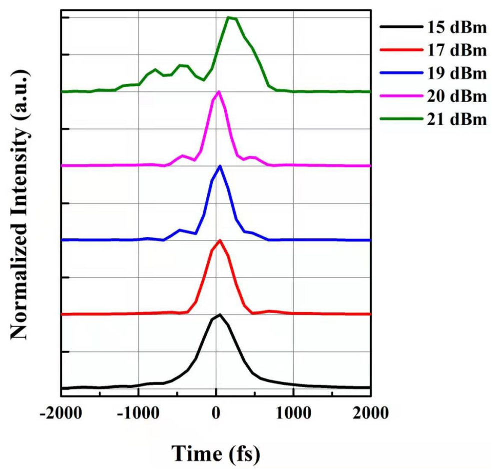

Fig. S2 | Optical time domain pulses obtained after pumping 500 m HNLF and 4 m SMF with different powers.

Section 3: Schematic diagrams of the experimental setup

The schematic diagrams of the experimental setup for the generation of the broadband OFC using silica HNLFs and fluorotellurite fibers are shown in Fig. S3. The selected section in (b) is the experimental set up for the generation of the ultra-short pulse.

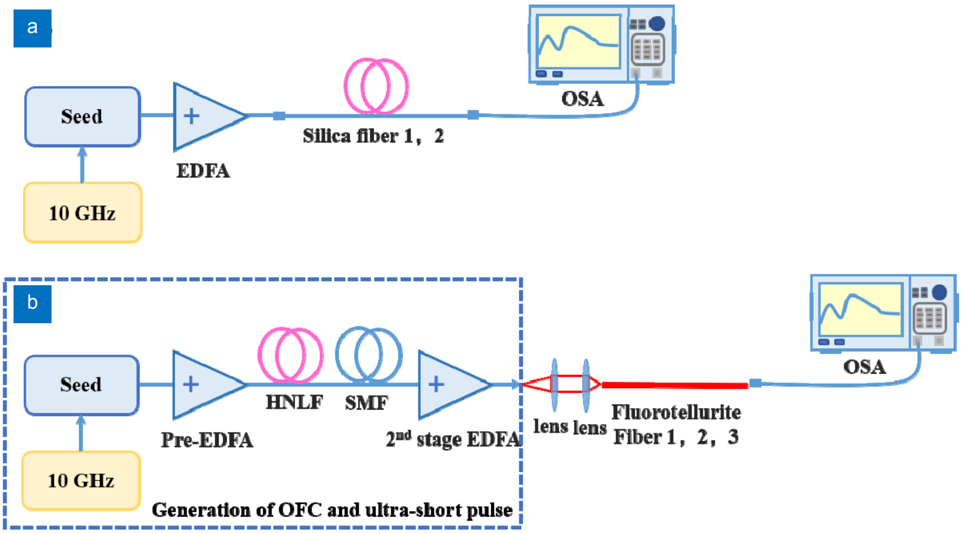

Fig. S3 | Schematic diagram of the experimental setup for the generation of the broadband OFC using (a) silica HNLFs and (b) fluorotellurite fibers. The selected section in (b) is the experimental set up for the generation of the ultra-short pulse.

Section 4: Complete optical spectra of the generated flat-topped OFC

The complete spectra of Fig. 4 are shown in Fig. S4. Figure S4(a) shows clear spectral sidelobes on either side of the flat-topped central region, which is an indicator that the pulse falls in the wave-breaking region[S1].

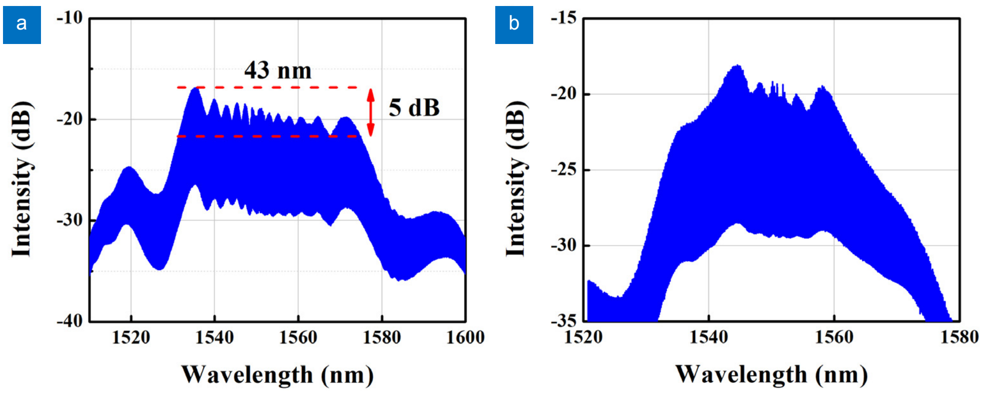

Fig. S4 | Complete optical spectra of the generated flat-topped OFC. (**a**) The 10 GHz repetition rate at 26.5 dBm pump power. (**b**) The 18.5 GHz repetition rate at 25.5 dBm pump power.

Reference

S1 Finot C, Kibler B, Provost L, Wabnitz S. Beneficial impact of wave-breaking for coherent continuum formation in normally dispersive nonlinear fibers. *J. Opt. Soc. Am. B* 25, 1938-1948 (2008).