Generation and Characterization of Fiber Laser Based Wideband Wavelength Tunable Narrow Linewidth Comb

N. Ohta[1], Y. Sakakibara[2], E. Omoda[2], H. Kataura[2], and °N. Nishizawa[1]

[1]Nagoya Univ., [2]AIST

E-mail: nishizawa@nuee.nagoya-u.ac.jp

Optical frequency comb is the highly accurate, equally frequency spanning spectrum, and it made a breakthrough in the field of metrology. The output spectra have quite a large number of longitudinal modes, and the optical energy is divided among the comb modes. If we demonstrate the wavelength tunable comb source, we can concentrate the optical energy at the specific wavelength, and we can achieve the power scaling of the comb mode.

We have been investigating wavelength tunable, narrow linewidth optical frequency comb using nonlinear fiber techniques [1,2]. In order to realize the low noise comb, the fiber length should be as short as possible.

In this work, we examined two types of spectral compression: (a) dispersion increasing comb profiled fiber (CPF) and (b) a pair of single mode fiber (SMF) and highly nonlinear normal dispersion fiber (HN-NDF). The comb properties of the output pulses were examined using balanced heterodyne beat measurement, and dual comb beat measurement with SC comb [3].

Figure 1 shows the optical spectra of generated wavelength tunable narrow-linewidth comb using dispersion increasing CPF. The narrow linewidth combs with the spectral width of 4 - 5 nm were generated at the wavelength range of 1.6 – 1.9 um. The RF beat signals between generated comb and stable cw-LD were observed with high SNR larger than 40 dB, as shown in Fig.2.

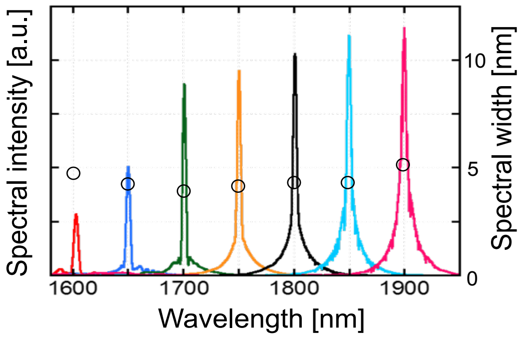

Fig. 1. Optical spectra and spectral widths of wavelength tunable narrow linewidth comb

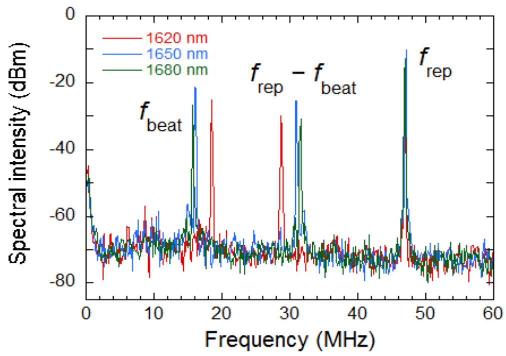

Fig. 2. RF beat spectra of tunable comb and cw-LD.

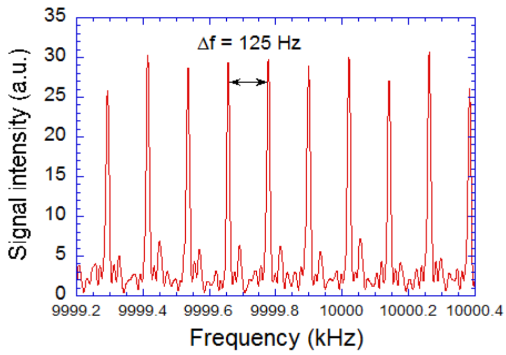

Fig. 3. Dual comb beat spectra between tunable comb and SC comb.

Figure 3 shows the observed beat signals when we used dual comb scheme with SC comb. The frequency difference Δf was 125 Hz. The equally frequency spanning RF beat signals corresponding to the tunable comb were observed clearly, and the comb structure with high SNR was confirmed.

References 1. N. Nishizawa et al, Opt. Express **18**, 11700 (2010), Opt. Express **24**, 23403 (2016). 2. N. Ohta, et al. CLEO2018, Stu4K.5. 3. N. Nishizawa, et al, IEEE J. Sel. Top. Quantum Electron. **24**, 5100409 (2018).