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Technique of optical frequency comb generation from a bismuth-based harmonically mode-locked fiber laser

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Optical frequency comb generators can offer several attractive applications such as wideband multi-wavelength lasers, ultra-short pulse generation, coherent optical waveform syntheses, ultra-fast signal processing, high resolution spectroscopy and optical frequency reference. High stability, high coherence, high efficiency, low noise, low cost, wide bandwidth and spectral flatness are commonly required for those applications. Among many potential comb sources, harmonically mode-locked fiber lasers are a popular solution owing to their abilities such as wavelength tunability, short pulse width, small timing jitter and high repetition frequency in the gigahertz region. However, since the harmonically mode-locked fiber lasers usually employ silica-based erbium-doped fibers as the gain media, the range of the wavelength tunability is limited to either the conventional wavelength band or the longer wavelength band. Furthermore, it is generally difficult for each frequency comb component generated by the harmonically mode-locked fiber lasers to have the same intensity. In this paper, we review a technique for producing a tunable and flat frequency comb from a 10 GHz bismuth-based harmonically mode-locked fiber laser. The output characteristics are as follows. The center wavelength can be tuned from 1535 nm to 1585 nm. The comb spectrum can be flatly broadened up to 2.4 nm (300 GHz) with 30 comb lines. The spectral width and the pulse width can be tuned from 0.23 nm to 2.4 nm and from 3.0 ps to 20.1 ps, respectively. Throughout the entire tuning ranges, this laser can maintain stable bit-error-free mode-locking operation within a received power deviation of 3.0 dB.

Biography

Yutaka Fukuchi received his BS and MS degrees in Electronics Engineering from Tokyo University of Science, Japan in 1998 and 2000, respectively and completed his PhD degree in Electronics Engineering from University of Tokyo, Japan in 2003. In 2003, he joined the Department of Electrical Engineering, Tokyo University of Science. Since 2009, he has been an Associate Professor in this department. From 2013 to 2014, he was a Visiting Research Fellow with the Department of Photonics Engineering, Technical University of Denmark. His research interests are nonlinear optics and their applications.

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