DUAL-COMB SPECTROSCOPY OF GREENHOUSE GAS BASED ON AN ERBIUM DUAL-COMB FIBER LASER

SIYAO YIN, JIE CHEN, XIN ZHAO, TING LI, ZHENG ZHENG, *School of Electronic Information Engineering , Beihang University, Beijing, China.*

Dual-comb spectroscopy holds the promise as real-time, high-resolution spectroscopy tools. It had been applied to measure the spectral features of a wide variety of samples. With the help of nonlinear optical spectral broadening schemes, gases with absorption in different spectral windows can be monitored using the dual-comb method[a]. Among them, methane is one that attracts much attention due to its important role in the greenhouse effect. Dual-comb spectroscopy based on a single mode-locked fiber laser has attracted more attention due to its simplification compared to the dual lasers systems. High-resolution optical spectroscopy had been demonstrated around the Erbium (Er) gain window by measuring the absorption of acetylene gas cell and other devices[b]. It had been suggested that certain degree of mutual coherence between two combs without stabilization, which is important for dual-comb applications, could exist due to some common-mode noise cancellation mechanisms.

In this work, dual-comb spectroscopy based on the nonlinear spectral broadening of a single laser dual comb source at the 1550 nm Er window is further investigated in ultralength (UL) wavelength band where the absorption of methane can be observed. The absorption line of methane around 1648 nm, which is 100 nm away from the lasing wavelengths of our seed laser, can be clearly obtained. The spectral signal to noise ratio improves significantly with the increase of the number of averaged interferograms. Despite the extra noise introduced by the nonlinear spectral broadening process, the absorption line of methane can still be resolved with good quality.

[a] K. Cossel, et al., Optica, 4, 724 (2017).

[b] X. Zhao, et al. Opt. Express 24, 21833 (2016).