























Fig. 6. (a) Spectra of two beat signals between CW-THz radiation and PC-THz comb and self beat signal of  $f_{\text{rep}3}$  (Media 1). (b) Spectral configuration of CW-THz radiation and PC-THz comb before and after tuning.

## 5. Conclusions

We demonstrated a widely and continuously tunable THz synthesizer traceable to the hydrogen maser linked to UTC-NMIJ. A combination of dual optical combs and the photomixing technique achieved a frequency uncertainty of  $10^{-12}$  in the THz frequency range. Furthermore, photomixing of a tunable OFS and a fixed one enabled us to extend the continuous tuning range of the CW-THz radiation up to 1.26 GHz while maintaining the unprecedented frequency uncertainty. We believe that it should be possible to further extend the tuning range to 990 GHz in the THz frequency region by use of a broadband photomixer, such as a PCA [3,18], because we have already achieved continuous tuning of 990 GHz in the tunable OFS. This THz synthesizer will be a powerful tool for broadband, high-precision THz spectroscopy, such as analysis of multiple chemical species in gas-phase spectroscopy [19]. Furthermore, the combination of the developed THz synthesizer and THz-comb-referenced spectrum analyzer will pave the way for establishment of frequency metrology in the THz region [1].

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