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Coherent broadband THz spectrometer using photomixers for accurate determination of complex dielectric function

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We discuss the development of a cw THz spectrometer for solid-state spectroscopy at low temperatures as well as high magnetic fields. The spectrometer is based on the principle of THz generation using frequency mixing of two near-infrared distributed feedback diode lasers with frequency stabilization [1]. The laser beat is converted into THz radiation by a photomixer, which efficiently generates THz radiation from 60 GHz to 1.8 THz. The THz radiation is detected by a second photomixer via homodyne mixing of the THz signal and the laser beat. A fast phase modulation technique using fiber stretchers is used to determine the amplitude and the phase at a given frequency with excellent reliability [2].
More recently, we have implemented a third laser which increases the phase accuracy by enabling a correction for phase drifts mainly caused by thermal fluctuations. Thus, the complex dielectric function can be determined very accurately with a very high frequency resolution. Furthermore, the performance of the photomixers at low temperatures down to 5 K and high magnetic fields up to 8 T has been tested extensively to integrate this spectrometer within a commercial magneto-cryostat for spectroscopic investigations. Various aspects of the above-mentioned developments will be outlined.
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[2] A. Roggenbuck, K. Thirunavukkuarasu, H. Schmitz, J. Marx, A. Deninger, I. Cámara Mayorga, R. Güsten, J. Hemberger, and M. Grüninger, J. Opt. Soc. Am. B, in print (2012).

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