

激光技术

高灵敏度激光吸收光谱中的微弱信号处理

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摘要 可调谐二极管激光频率调制吸收光谱(FM-TDLAS)技术是一种高灵敏度的痕量气体检测方法。为改善以CH₄为目标气体检测系统的信噪比,提高系统的检测灵敏度,以双平衡混频器(double balanced mixer)为核心,设计了一套用于提取被噪声淹没的微弱信号的调制解调高频相敏探测器。在对高频相敏探测器进行具体设计和分析的基础上,结合实验,利用CH₄气体在1653nm附近的近红外吸收光谱,对整体电路的性能进行了测试,

获得了具有较高信噪比的二次和一次谐波信号,检测灵敏度可达 10×10^{-6} 。

关键词 [光谱学](#) [频率调制](#) [微弱信号处理](#) [相敏探测](#) [CH₄](#)

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Processing of faint signal in high-sensitivity laser absorption spectra

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Abstract Frequency modulation tunable diode laser absorption spectroscopy (FM-TDLAS) is a high-sensitivity trace gas detection technique. In order to improve the signal to noise ratio (SNR) of a methane gas detection system, and to enhance detection sensitivity, a high-frequency phase-sensitive detector with Double Balanced Mixer (DBM) as the core and a modulation circuit were designed to detect the small signals in strong noise. Based on the design and analysis of the high-frequency phase-sensitive detector and the modulation circuit of the system, the performance testing for the overall circuit in the FM-TDLAS system was carried out in the experiment, in which the near-infrared absorption spectrum of CH₄ gas around 1653nm was utilized. The experiment shows that the first harmonic and second harmonic signals with high SNR are obtained, and the detection sensitivity reaches 10×10^{-6} .

Key words [spectroscopy](#) [frequency modulation](#) [faint signal processing](#) [phase sensitive detection](#) [CH₄](#)

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