传感技术学报
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用于燃气温度测量的单激光器吸收光谱系统设计

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摘　要：

可调谐半导体激光器吸收光谱（TDLAS）燃烧诊断技术利用双线方法可实现燃烧环境中温度的非接触、实时在线测量。本文针对1000-2500K典型碳氢燃料燃烧环境，基于HITRAN光谱数据库，对通信用分布反馈式半导体激光器工作波段（1.25-1.65μm）内H2O吸收谱线进行优选分析，发现7153.748-7154.354cm-1双线谱线对满足单激光器调谐条件，并且对高温燃气温度测量具有较好的抗干扰能力和测温灵敏度。因此，选用1397nm半导体激光器设计了用于燃气温度测量的单激光器吸收光谱系统，并将其应用于平面火焰炉燃气温度测量，测量结果与热电偶测量结果比较，最大相对差值不超过10%。

关键词：光学传感器设计；TDLAS；吸收谱线选择；HITRAN；温度测量

Design of a Single Laser Temperature Sensor Based on TDLAS for Combustion Gases

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Abstract:

Tunable Diode Laser Absorption Spectroscopy (TDLAS) can offer significant advantages for non-intrusive and in situ measurement of temperature in combustion environments by using two-line technique. In the present work, with regard to the typical hydrocarbon combustion environment with the temperature range 1000-2500K, transitions of water vapor are simulated and analyzed by using HITRAN database in the spectral region of distributed feedback (DFB) diode laser (1.25-1.65μm). The result shows that 7153.748-7154.354cm-1 line pair can satisfy the modulation range of a single diode laser, and has advantage of anti- interference and sensitivity for high temperature combustion gases. Therefore, a single laser temperature TDLAS sensor basing on 1397nm diode laser is designed and applied to measurement of temperature in flat flame burner. Comparison with thermocouple measurements, the maximum relative difference is less than 10%.

Keywords: Optical sensor design, TDLAS, transitions selection, HITRAN, temperature measurement

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