Laser-based Trace Gas Detection for Applications in Biology and Medicine

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Laser photoacoustic spectroscopy offers an elegant and relatively simple way to perform highly sensitive trace gas detection, owing in particular to the background free nature of this technique. As the photoacoustic signal is directly proportional to the laser power and to the absorption strength, it is advantageous to use powerful laser sources (CO_2-, CO-lasers, next to OPO's) in the mid-infrared wavelength region (3-11 μm) where most molecules possesses their strongest absorptions. These instruments typically reach detection limits around 1 part per billion for small molecules and possess a time resolution of only a few minutes. This has made lasers applicable for a wide variety of applications in biological and medical research.
Examples will be shown of trace gases emitted during ripening and fermenting of fruit, which is important for its storage and transport conditions. Oxidative stress and pathogenic attack in plants and fruit was also studied during chilling stress (cucumber leaves), submergence (rice seedlings) and bacterial infection (tobacco leaves and tomatoes). This research is underway to explore medical sciences with the detection of exhaled gases from the human breath as indication for diseases and disorder symptoms.

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