ETH zürich

Licensing Opportunity

Rotational optical delay line assembly for rapid FT-IR spectroscopy measurements

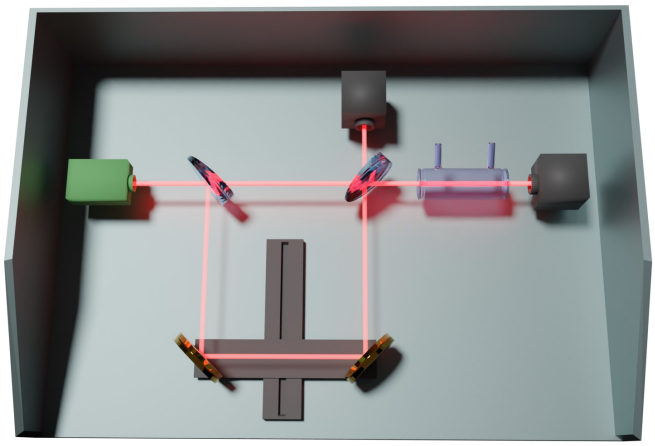

fig. 1 Conventional set-up of an FT-IR spectrometer with linearly displacing mirrors.

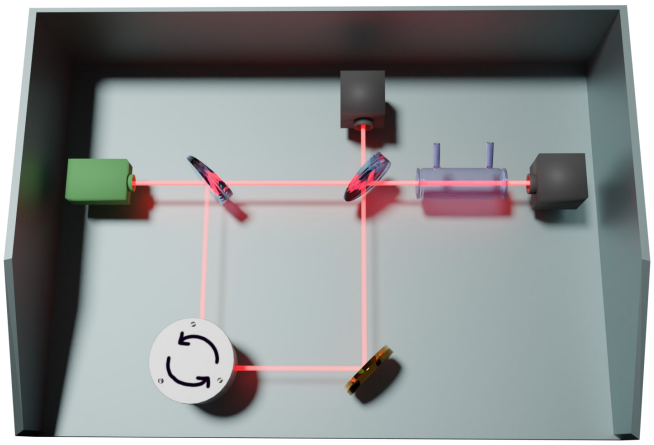

fig. 2 Modified delay-line with continuously rotating mirror assembly, which increases the data acquisition rate.

Application

Fourier Transform Infrared (FT-IR) spectroscopy is an established technique for the fast scanning of sample compositions. The presented technology pushes the scanning time into the subsecond range making it an ideal tool for monitoring very fast industry processes such as changes in liquid or gas flows.

Features & Benefits

- decoupling spectral resolution from acquisition speed
- large optical bandwidth (no dispersive elements)
- compatible with various light sources
- small space requirements of the assembly

Publications

- “Frequency chirped Fourier-Transform spectroscopy”, arXiv:2204.12396 [physics.optics] https://doi.org/10.48550/arXiv.2204.12396
- Patent pending

ETH transfer
transfer@sl.ethz.ch
www.transfer.ethz.ch
+41 44 632 23 82

Reference 2021-087

Invented by:
Institute for Quantum Electronics, G. Scalari, S. Markmann, M. Franckié, A. Forrer, M. Shahmohammadi

Technology Readiness Level

Background

FT-IR spectroscopy records the interference of two light beams as a function of path difference between the two beams. In a conventional set-up (see fig. 1) the pathlength is changed by a linear delay-line. At the beginning of the measurement the mirrors are accelerated and towards the end decelerated. The change of momentum is dead-time for the data acquisition. This is a major disadvantage for a technique which is applied in fast scanning scenarios.

Invention

The traditional linear delay-line is replaced by a rotational stage (fig. 2). The rotational stage comprises a reflector set, which rotates in the incidence plane of the laser beam. The beam undergoes multiple reflections within the reflector-set such that a delay is generated by periodically alternating the beam-path. The rotating optics introduce a frequency chirp in the exiting beam, which is accounted for by an initial calibration (e.g. HeNe laser). The calibration will also remove any imperfections of the rotating optics. Furthermore, the reflector geometry is chosen such that the spatial Doppler shift across the beam diameter is reversed upon exiting the rotational stage.

The data acquisition rate of the presented set-up is limited by the rotation speed of the optical elements. An arbitrary number of scans can be performed consecutively without having to accelerate or decelerate any mechanical component. The set-up is suited for a wide optical frequency range including the mid-infrared, which covers the molecular fingerprint region. Applications of this technology comprise the real-time monitoring of processes in industry.