Seminario

Detecting trace amount of contamination or additives in commercial-grade gasolines by means of THz-TDS Time-of-Flight Spectroscopy

Dr. Kamil Stelmaszczyk

Researcher
CENTERA Laboratories, Institute of
High Pressure Physics, Warsaw, Poland

Abstract

Terahertz Time-Domain Spectroscopy (THz-TDS) has recently become an attractive analytical technique in gas, liquid or solid-state phases which uses ultra-short, picosecond bursts of terahertz radiation for probing of material properties. Its attractiveness is directly related to a method of measurement allowing to register the electric field vector changes as a function of time and thus obtain information on both real and imaginary part of the refractive index of the material. However, to do so, one has to apply sophisticated Fourier analysis of in particular for optically thick samples with absorption.

We show that straight forward and fast determination of propagation times of THz pulses transmitted through gasoline samples is adequate to detect small, a few hundred ppm fractions (percent by weight %wt.) of water and other contamination in commercial-grade gasoline.

A series of measurements conducted to examine time-profiles of picosecond THz pulses, i.e. their peak amplitude time-positions and delays, was used to investigate compositional change in gasoline. More precisely, the Time-of-Flights (TOFs) of the pulses passing through pure gasoline samples were compared with those transmitted through gasoline mixtures containing de-ionized water and isopropanol at calibrated weight fractions. It was found that the difference between the TOFs expressed as a function of admixture concentration has a universal linear character, independently of an admixture type.

In order to explain this linear dependence, the obtained results were compared with the Gladstone-Dale mixing rule, which presumes that refractive index of a pseudo binary mixture can be expressed as a weighted sum of refractive indices of solvent and dissolved substance with the weights given by mass fractions of the two constituents. We show that when applying this simple model an excellent agreement between measurements and theoretical calculations is obtained, proving good solubility of dissolved substances in gasoline, when the assumption on pseudo binary gasoline mixture is fulfilled [1].

[1]. K. Stelmaszczyk, et al., Appl. Sci. 12, 1629, 2022.

Calendar QR

Martes, 25 de octubre del 2022
Aula V @ 13:00