WATER VAPOR INTERACTION WITH LIQUID ETHANOL WAS INVESTIGATED USING THE TERAHERTZ TIME-DOMAIN SPECTROSCOPY TECHNIQUE.

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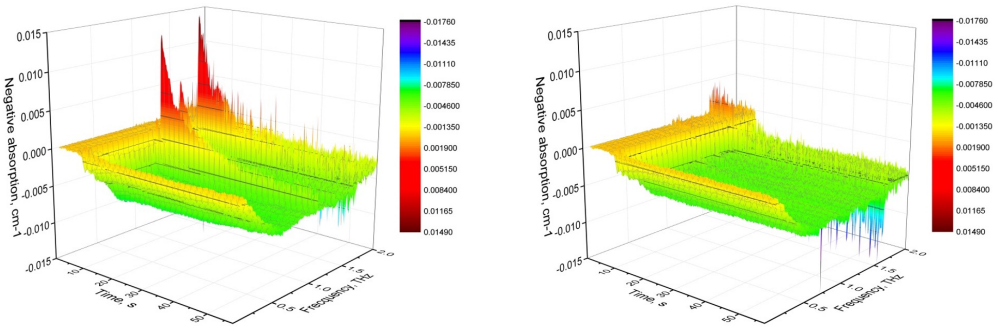
This study develops a novel ethanol purity monitoring method based on the terahertz time-domain spectroscopy system. Historically, ethanol was used as a general anesthetic and has modern medical applications as an antiseptic, disinfectant, and solvent for some medications. It is used as a chemical solvent in the synthesis of organic compounds and as a fuel source. Some applications require the use of ultra-pure ethanol. For example, in the pharmaceutical industry, even a small amount of water in the solvent may cause problems in chemical reactions during research for purposes such as drug discovery. In this case, a real-time monitoring method is a promising analytical technology to guarantee the quality of the manufactured products. Our method is a promising solution for the real-time measurements of chemical reactions for quality control in pharmaceutical manufacturing.



(a) (b)

Fig. 1. Temporal development of transmittance spectra of 34 cm tube after injection of 10 ml ethanol. (a) 99.8% rectified ethanol and (b) 96% mediacal ethanol

The experiments were carried out by injecting small amounts of liquid alcohol into a closed tube filled with atmospheric air. The transmittance spectra of such a tube depended on the terahertz absorption of water and alcohol vapor and the interaction of water vapor with the liquid alcohol surface. In the vapor state, the absorption intensity of the alcohol molecule is similar to that of the water molecule, but the terahertz absorption spectra of both materials are significantly different. Moreover, a strong interaction between liquid alcohol and water molecules in the vapor state was observed (Fig. 1). Vapor spectroscopic testing has been shown to prove a more sensitive detection of low concentrations of water in ethanol than liquid phase [1] testing.

[1] K. Horita, K. Akiyama, H. Satozono,T. Sakamoto, K. Takahashi, Terahertz Time-Domain Attenuated Total Refection Spectroscopy by a Flow-Through Method for the Continuous Analysis of Hydrous Ethanol