Novel Characterization Techniques in Materials Science

Molecular and Nano Archaeology Laboratory and Department of Materials Science and Engineering Seminar Series

Friday, April 25th, 2013 at 14:00-16:00pm
Engineering V, Room 2101

"Advantest Terahertz Program – Implementation of Technology & Applications"

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Advantest America, Inc.

Interest in the terahertz frequency range which lies between the mid-infrared and microwave regions of the electromagnetic stems from its unique combination of material transparency and spectroscopic information. Terahertz radiation interacts strongly with dynamic systems having lifetimes in the picosecond range and low energy vibrational transitions with photon energies on the order of 3-300 cm^{-1}. Therefore, THz spectroscopy provides a particularly powerful means for probing the fundamental properties of materials, as well as their molecular motions. Advantest has investing heavily in the development and commercialization of THz technology, with the goal of making simple, turnkey solutions for practical use. With laboratories in Sendai, Japan and Princeton, NJ they are also expanding the range of applications of THz spectroscopy and imaging. The technique is non-destructive and the high transparency of most dielectric materials to terahertz radiation yields much greater depth of penetration than is possible with optical techniques. Practical uses of the technology are numerous and varied, including characterization of pharmaceuticals, micro-particulates, thin films, quantitative crystallinity, polymorphism, explosive chemical detection, advanced materials like graphene, skin burns, skin cancer, skin drug absorption, and process automation technology such as roller compaction, paper manufacturing, and Li-Ion battery manufacturing.

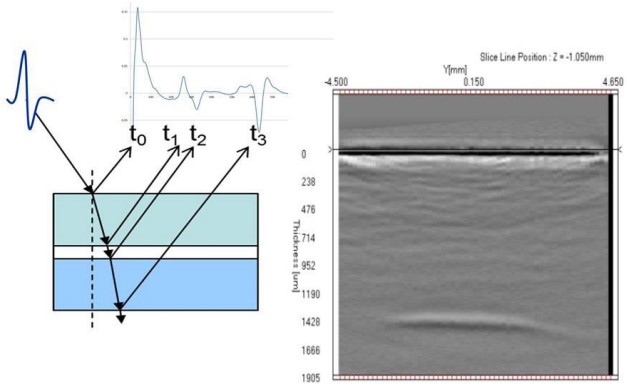

Fig. 1. Terahertz frequency time-of-flight measurement technique enables layer thickness measurements through dielectric solids, with lower limit thickness detection range in the tens of microns

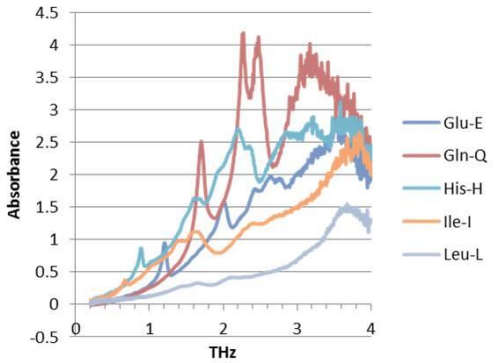

Fig. 2. Spectroscopy performed with Terahertz frequency radiation allows for observation of intermolecular frequency response: shown are spectral fingerprints of several amino acids