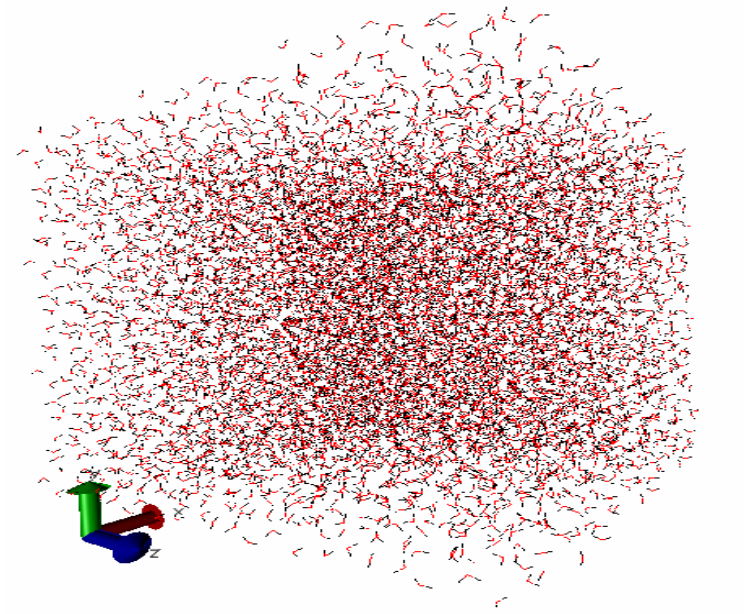

Our group specializes in optical and electrical characterization and optimization of electronic and photonic materials and devices including uncooled photodetectors, light-emitting diodes for the mid-infrared, photovoltaics and solar cells. Our research encompasses optical and terahertz spectroscopy of thin film electronic materials and structures. During last 8 years, the research focus of the group was extended to nclude development of sub-THz biosensing technology for environmental and bio-medical applications. Through support from the Keck Foundation and DOD grants, Vibratess LLC, a spin-off from the University of Virginia, developed the sub-THz resonance spectroscopy and instrumentation for detecting, identifying and characterizing biological macromolecules and microorganisms. The highly sensitive system utilizing vibrational resonance absorption technology has already demonstrated sufficient resolution to detect and identify a single cancer cell - the result that potentially can be used as a molecular diagnostic approach for early cancer detection and prognosis.

Globus Research Group

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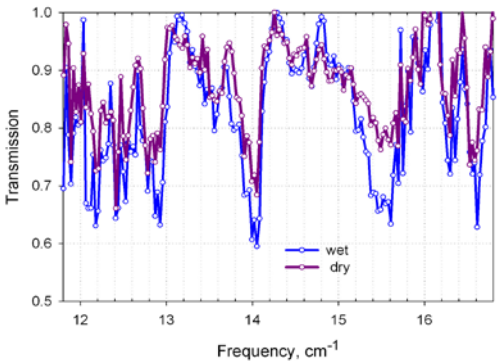
"Developing terahertz spectroscopy to be used for the study of bio-materials."

UNIVERSITY of VIRGINIA
ENGINEERING

Terahertz Spectroscopy Biosensing Technology

Vibrational resonance spectroscopy in the THz range is a fast emerging technique for fingerprinting biological molecules and species with broad potential applications such as biomedicine or detection and identification of bio-targets. THz radiation interacts with the low-frequency internal molecular vibrations involving the weakest hydrogen bonds and other weak interactions by exciting these vibrations. The subThz/Thz regions of absorption spectra of bio-molecules and species reveal these low frequency molecular motions as resonances, which can serve as fingerprints specific to molecules. The characteristic resonance frequencies of vibrational modes are unique for different biological objects, and can be used as their spectroscopic signatures. The uniqueness of THz spectroscopy to opens potentially many applications such as real time monitoring of biological processes, detection and identification of harmful biological species, food contamination control, water quality monitoring and others. The spectral range below 1 THz is especially attractive for practical applications because of low disturbance from liquid water or other solvents, and from water vapor absorption. A big advantage of THz spectroscopy is that it is an all-optical method and is nondestructive for living species. Our research addresses the key problems impeding further development of THz spectroscopy as a very sensitive and reliable technique for characterizing the specificity of spectroscopic signatures of complex molecules. We seek to perfect the use of THz spectroscopy for the fast and effective detection and identification of biomolecules and species. Specifically, we are working to miniaturize THz spectroscopic technology to allow for characterization of samples which range between a few nanometers to several microns. Additionally, we are characterizing terahertz/bio interactions to allow for the better design of devices.



We have developed a new method of spectroscopic characterization of macro-molecular artificially designed structural elements of a modern nano-bio technology. The figure to the left shows the THz signature of artificial DNA nanocrystal, bio-molecular architecture built in the group of Prof. M. Norton, Marshal University, WV. (Submitted JPC (A), 2013, http://pubs.acs.org)

RECENT RESEARCH DEVELOPMENTS

- *Highly resolved sub-terahertz vibrational spectroscopy of biological macromolecules and cells*. Globus, T., Moyer, A., Gelmont, B., Khromova, T., Lvovska, M., Sizov, I., & Ferrance, J. (2012) IEEE Sensors Journal, **13**, 72-79.
- *Developing short models for DNA macromolecules and predicting THz spectroscopic signatures of DNA from pathogen strains of E.* coli bacteria cells. Globus, T., Sizov, I., Gelmont, B. (2013) Advances in Bioscience and Biotechnology. doi:10.4236/abb.2013.43A065

RECENT GRANTS

- DOD/ARO – 4.6 Terahertz Science & Technology: Sensing Biomolecular Nanostructures & Photoinducer Transitions between Metastable States
- DOD/ARO – New Concepts for Detection of Biological Targets: Terahertz Signature Database Generation
- DOD-DTRA – Select Biomolecule Recognition Signatures in Terahertz Region of EM Spectrum

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