

Project 6.5 Terahertz Metasurfaces for Detection of Viruses and Other Biological Substances

Supervisor: prof. Wojciech Knap / dr Maciej Sakowicz

Institute: Institute of High Pressure Physics PAS

Laboratory: Terahertz Laboratory (TeraGaN)

www: www.unipress.waw.pl

Background:

Detection of biomatter like viruses, proteins, etc. is of great importance for life sciences, mainly biology, biomedicine, and pharmaceuticals. The terahertz (THz) band has some interesting features that make it an interesting and emerging technological alternative in the field, therefore has high potential in biosensing applications. The absorption of THz ray in molecular and biomolecular systems is dominated by the excitation of intramolecular and intermolecular vibrations, which make fingerprints in molecule and biomolecule detections. Therefore not only we expect biomatter to influence the refractive index but we expect resonances in THz range. THz metasurface biosensors have been crucial in alleviating one of the biggest problems in THz biological sensing, which is the stark difference between the typical size of microorganisms ($\approx 1 \mu\text{m}$) and the wavelength at THz (≈ 30 to $1000 \mu\text{m}$) that makes this radiation insensitive to these small details. Metasurface biosensors hold the promise to overcome these limitations taking advantage of the unprecedented freedom to engineer the metasurface parts properly. THz metamaterial sensing is not only signal-enhancing but also easy to operate, which attracts significant attentions from researchers in diverse fields.

Aim:

The project aims in realization of a prototype of detection system of biomatter. Our goal is to study a possibility of trace detection of bio-particles like for example viruses and proteins with terahertz metasurfaces using our own terahertz optopair.

Requirements:

- Completed studies in the field of physics, electronics, materials engineering, or other related subjects that allow you to start working as a doctoral student - scholarship holder
- Readiness to obtain the status of doctoral student in the mentioned fields;
- Knowledge of English to a degree that enables understanding of professional literature in a given field, as well as presentation of results and discussion;
- Ability and passion for scientific and research work;
- Demonstrating understanding of the basics of solid state physics including semiconductor physics;
- Experience in RF electromagnetic simulations, preferably in THz range and using COMSOL Multiphysics software.
- Experience in bio related research will be an asset.
- Experience in semiconductors' processing (cleanroom experience) will be an asset.
- Readiness to work in the Terahertz Laboratory (TeraGaN) at the IHPP PAS <http://www.unipress.waw.pl/teragan/>