Master's Thesis

16. Dezember 2021

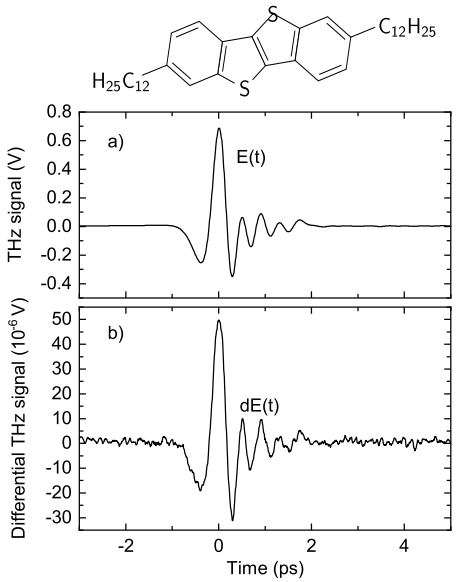
Terahertz characterization of molecular semiconductors

Background: One of the biggest obstacles that limit the application of organic semiconductors in electronics is their low charge carrier mobility. The goal of our research is to advance the understanding of the fundamental properties that define the mobility, i.e. the charge carriers' effective masses m^* and their scattering times τ. These properties can be deduced by THz spectroscopy, which maps elementary carrier motions on the nanoscale.

Topic and task: The applicant will perform THz electromodulation experiments on novel molecular semiconductors, which are developed within our collaboration with Y. Geerts at the university of Brussels. The primary focus of the work will be on the deduction of m^* and τ for various materials. From the data we expect new insights into those material properties that lead to enhanced charge carrier mobilities.

The experiments will be performed in teamwork with group members that fabricate the required devices from the molecular semiconductors. We will acknowledge participation in the fabrication process by physical vapor deposition (PVD) and chemical vapor deposition (CVD).

Status: The experimental setup for THz spectroscopy and all required equipment is available. Software for driving the setup as well as for the analysis of experimental data were developed in previous work.



Top: Terahertz pulse after transmission through a molecular semiconductor device. Bottom: Differential transmission when the device is electro-modulated. Application of a voltage leads to the injection of charge carriers into the molecular semiconductor. The carrier motion within the field of the THz pulse causes partial absorption and disperion of the pulse. From these data τ and m^* can be deduced by model calculations that consider the Drude response of the charge carriers to the THz field.

References:

- https://doi.org/10.1063/1.4887237
- https://doi.org/10.1021/acs.jpclett.7b02304

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