Thermoreflectance imaging

Bachelor or Master thesis in AG Callsen proposition

The "Arbeitsgruppe" (AG) Callsen is focused on the thermal characterization of semiconductors, which, e.g., comprises the determination of the thermal conductivity. Our meaurements are based on non-invasive specotroscopy like Raman- or reflectivity-based thermometry. Until now, most measurements in our labs are based on probing the sample temperature via the Raman shift. The goal is to construct and test a new setup that is using the variation of the reflectivity of a material to derive any variation of temperature.

During this work you will construct a setup to have the possibility to image a sample via a Peltier-cooled CCD based on a self-build Köhler illumination with a green diode. In addition, samples with metallic transducers will be prepared. This thin layer of metal (e.g., 80 nm of Au or Al) on the sample will allow probing the temperature based on variations of the reflectivity. Heating will occur via metail transducers or via a separate heat laser, which will consequently enable the observation of heat diffusion on sub-µm length scales. The objective is to obtain thermal images similar to Fig. 1. During this work we will first focus on thermometry on Si before transitioning to GaN. Furthermore, also thermal simulations based on COMSOL, a finite element solver software package, can be performed to obtain a first comparison between the experimental data and simulated temperature distributions.
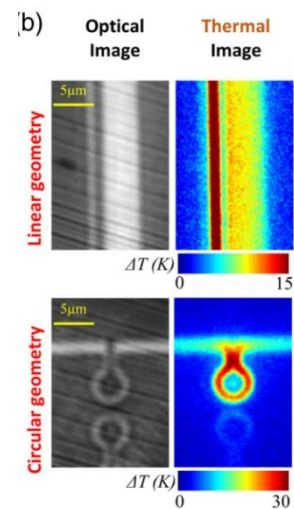

Figure 1: Example for thermal imaging via the thermoreflectance technique. [Phys. Rev. B 105, 165303].

Project aims:

- **Setup Construction:** Assemble and optimize the experimental apparatus.

- **Setup Validation:** Ensure the system operates as intended through testing and calibration.

- **Sample Preparation and Characterization:** Prepare and analyze samples for the envisaged experimental investigations.

- **Measurement and Analysis:** Perform measurements and compare your results with simulations using the finite element method (FEM, COMSOL).

Your Profile:

- Eager to deepen your knowledge in solid-state physics.
- Interest in gaining hands-on experience in experimental physics.
- Strong communication skills and a collaborative mindset.

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