Universität Basel

Research Project

QUSTEC PhD fellowship - Phonon interference effects in superlattice nanowires and nanowires junctions through thermal transport experiments

Third-party funded project

Project title QUSTEC PhD fellowship - Phonon interference effects in superlattice nanowires and nanowires junctions through thermal transport experiments
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Project Website https://www.eucor-uni.org/en/qustec/
Project start 01.01.2020
Probable end 31.12.2023
Status Completed

Phonons are responsible of heat transport in condensed matter. The capability to control heat transport at the nanoscale is relevant for different technological applications ranging from thermoelectric to heat management. In particular, thermal management in nano-electronics and other nano-systems has become the bottleneck for device scaling and performances in electronics.

Due to the wavelengths and mean free paths of phonons, thermal transport at the nanoscale can be significantly different from thermal transport at the macro scale. Furthermore, the progress in nanofabrication enables the design and fabrication of nanostructures that can control heat transport by means of interference effects, achieving coherent phonon transport, and allowing exciting experiments (see e.g. Nature **503**, 209 (2013)).

In the frame of this project, we propose nanowires as platform for investigating and designing the phonon interference effects because they offer unique possibilities in terms of heterostructuring (i.e. combining materials that cannot be joined in 2D because of lattice mismatch and realizing crystal phase superlattices). Specifically, we want to explore superlattice nanowires and nanowires junctions. Both systems are ideal platforms for exploring phonons interference effects.

Thermal transport will be investigated measuring the thermal conductivity of the nanowires with the so-called thermal bridge method, consisting of suspended SiNx membranes with implemented metallic coils, which can be used both as heaters and thermometers. Thermal transport experiments at the nanoscale are extremely challenging since they require the measurement of heat flows that are quantified in temperature gradients.

Financed by
Commission of the European Union

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