熱輸送のスペクトル学的理解と機能的制御
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# レイフォノニクスによる高度な熱流マネジメント

## §1. 研究成果の概要

This year, I focused my efforts on the experimental measurements of the phonon mean free path – the average distance that phonons can fly until a scattering event. First, I fabricated two sets of samples that consist of suspended silicon membranes with arrays of nanoslits. The nanoslits had varied spacing between them, which allowed probing the mean free path. Using optical experiments, I measured the thermal conductivity of the samples. With the help of my collaborators, I adopted an analytical model from literature and used it to extract the mean free path spectra of the silicon membranes from the measured values of the thermal conductivity.

Our results show that in 145-nm-thin membranes at room temperature phonons can freely fly as far as 30 – 300 nm. As we decreased the temperatures, the mean free paths become longer, and the range shifted to 100 – 600 nm at 4 K. These data explain why room-temperature heat conduction appears diffusive at the length scales of several hundreds of nanometers, whereas low-temperature heat conduction at this scale becomes quasiballistic.