HUANG LAB.

Fluid-like phonon transport in solids

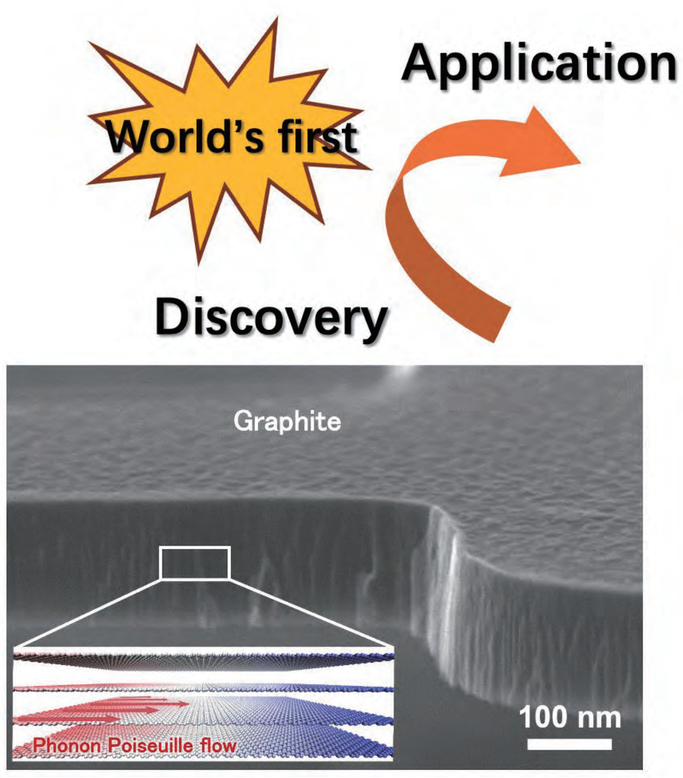
Department of Informatics and Electronics

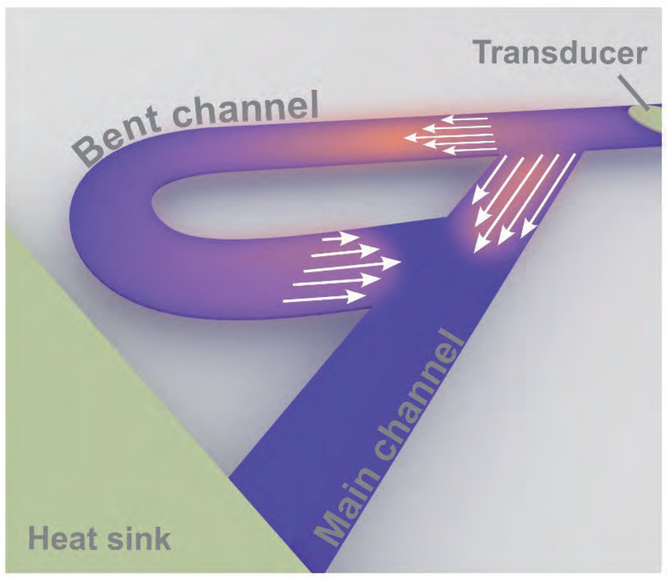
Quantum Hydrodynamic Engineering

https://www.nlab.iis.u-tokyo.ac.jp/

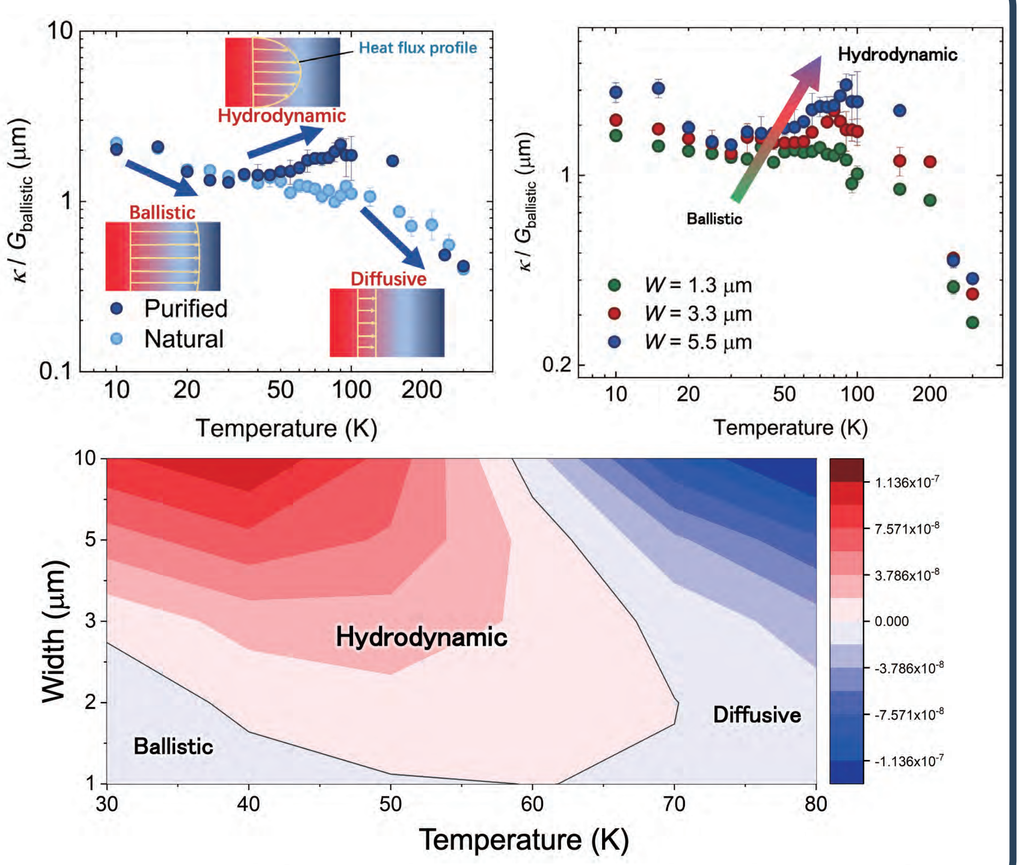
Phonon Hydrodynamic Thermal Transport

This research aims to develop a novel technology for fluidically controlling phonons, the particles that carry heat. Graphite possesses a much higher thermal conductivity than copper and is expected to be applied as a heat dissipation material. By leveraging the effects of "phonon hydrodynamics," in which phonons behave like a fluid, we successfully doubled the thermal conductivity under appropriate conditions. Furthermore, by applying the structure of a "Tesla valve," which controls fluid flow in a unidirectional manner, to a solid-state system for the first time, we achieved thermal rectification, imparting directionality to heat flow. It paves the way for the development of next-generation heat dissipation and thermal control devices, directly contributing to higher performance and greater energy efficiency in electronic devices. This pioneering research is expected to find applications not only in the semiconductor field but also across a wide range of industries.

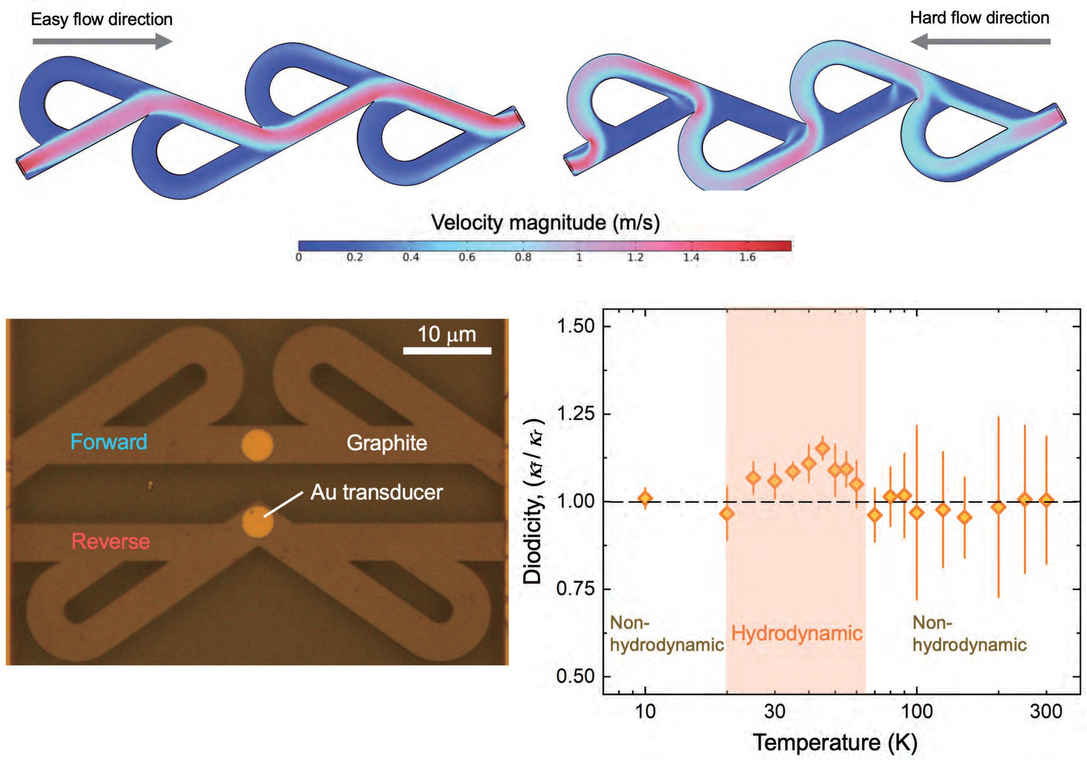




Phonon Poiseuille Flow



Graphite Thermal Tesla Valve



Probing Phonon Hydrodynamics

Advanced Thermal Management