

---

Mika Prunnila

## Strain Tuning of Electron-Phonon Coupling in Semiconductors

VTT Technical Research  
Centre of Finland, P.O.Box  
1000, FI-02044 VTT, Espoo,  
FINLAND

---

Operation of electron refrigerators and thermal detectors, such as bolometers, depends on the strength of the coupling of the electrons to the thermal bath. The coupling is, in the end, determined by the thermal electron-phonon coupling (TEPC), i.e., the thermal conductance between the electron and phonon systems. TEPC depends strongly on the microscopic details of the system at hand. In semiconductors and also in graphene the coupling can be tuned, for example, by strain and by adjusting the carrier concentration. Strain-tuning of TEPC has been investigated theoretically and experimentally in many-valley systems [1,2] and applied in enhancing the performance of silicon based electron refrigerators [3] and bolometers [4]. However, the effect of strain on TEPC is orders of magnitude smaller than suggested by the theory. We will discuss this discrepancy and other heat dissipation channels that can become dominant at low temperatures.

### References:

- [1] M. Prunnila, Phys. Rev. B 75, 165322 (2007).
- [2] J.T. Muhonen et al. Appl. Phys. Lett. 98, 182103 (2011).
- [3] M.J. Prest et al., Appl. Phys. Lett. 99, 251908 (2011).
- [4] T. Brien et al., Appl. Phys. Lett. 105, 043509 (2014).

