W-PL

"Measurement of Quantized Energy Transport"

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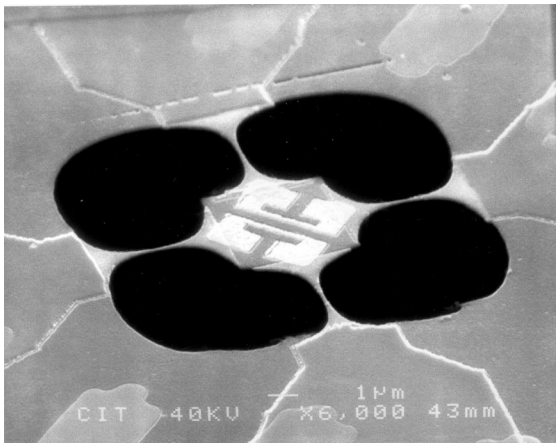
We have shown experimentally that the thermal conductance through discrete, one-dimensional, ballistic phonon channels is quantized, $G=\pi^2 k_B^2 T/3h$[1,2]. We have developed novel, 3D nanostructures, with feature sizes of order ~100nm to enter and reveal this mesoscopic limit for phonons. We will describe the techniques and implications of this measurement, and describe work in progress where we will explore the limits of heat capacity in these and more advanced nanoscale devices [3]. Using preliminary estimates, we anticipate realization of a bolometer with microsecond response time and energy sensitivity at the level of single terahertz photons. In addition, we will briefly describe another set of experiments which are underway at LPS and Caltech, to prepare and measure nanomechanical resonators at the quantum limit, $k_B T \sim h\nu$. These will open the exciting possibility of entangling nanomechanical systems with coherent electronic systems, thus allowing access to a new regime "***Q****uantum* ***E****lectro-****M****echanics* " [4].



Nanofabricated sample which demonstrated quantized thermal conductance.

[1] K. Schwab, E. Henriksen, J. Worlock, and M. Roukes, *Nature* **404**, 974 (2000).
[2] K. Schwab, J.L. Arlett, J.M. Worlock, M.L. Roukes, *Physica E* **9**, 60-68 (2001).
[3] M. Roukes, *Physica* B **263-264**, 1 (1999).
[4] K. Schwab, to appear in the proceedings of the *International Conference on the Experimental Implementations of Quantum Computing* (IQC01).

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