# Silicon Nanowire Thermoelectrics

Kedar Hippalgaonkar[1], Renkun Chen[1], Baoling Huang[1], Karma Sawyer[1], Ming Zhi Li[1], Bair Budaev[1], Jongwoo Lim[2], Jinyao Tang[2], Padraig Murphy[3], Joel Moore[3], Peidong Yang[2], Arun Majumdar[1]

[1]Department of Mechanical Engineering, [2]Department of Chemistry, [3]Department of Physics, University of California, Berkeley

khgaonkar@berkeley.edu

Silicon has long been the material of choice in the electronics industry due to its tunable electrical properties and abundance in nature. Backed by a multi-billion dollar industry, Silicon Technology is scalable, cheap and mature. On the other hand, with 90% of the world's power generated by heat engines operating at 30-40% efficiency on conventional fossil fuels, about 15 Terawatts of energy is lost to the environment [1]. Our objective in this project is to exploit the vast expertise of knowledge about Silicon and prove the capability of this unique material in energy harvesting. Efficiency of thermoelectric modules depends on a factor called the figure of merit (ZT) of the material components, which is a function of the Seebeck coefficient, electrical conductivity, thermal conductivity and absolute temperature [1].

$$ZT = S^2\sigma T/(k_{lattice}+k_{electronic})$$

We measure directly the thermal conductivity of individual nanowires by microfabricated devices consisting of platinum micro-heaters and thermometers on top of suspended silicon nitride films [2,3,4].

By decreasing the lattice contribution to thermal conductivity of Silicon by about 2 orders of magnitude, the ZT can hence be improved proportionately to compete with commercially available TE devices. We have developed many ways of fabricating these one-dimensional structures that exhibit such unique properties. Our approach to the energy harvesting problem is hence two-fold: 1) we measure thermal and electrical properties of individual nanowires to carefully understanding the underlying transport mechanism, 2) fabricate device-level systems that can be made in a batch-process in a commercial setup for use in waste heat recovery.

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