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Diffusion and Phonon-drag Thermopower in Gated Silicon Nanoribbons HYUK JU RYU, ZLATAN AKSAMIJA, DEBORAH PASKIEWICZ, SHELLEY SCOTT, MAX LAGALLY, IRENA KNEZEVIC, MARK ERIKSSON, UNIVERSITY OF WISCONSIN-MADISON TEAM — Thermoelectric devices are attracting interest for the targeted cooling of local hotspots in integrated circuits and the harvesting of waste heat to generate power. Special interest in silicon as a thermoelectric material arises from the possibility of monolithic integration, significant reduction in thermal conductivity for nanopatterned silicon wires, and the potential to use bandstructure engineering to improve the power factor. We present measurements of the thermopower in gate-tunable silicon nanoribbons. The gate voltage effectively modulates the thermopower by changing both the 2D electron density and the confinement electric field. The thermopower varies by almost a factor of four in the density range studied. We understand much of this variation and its temperature dependence by considering the roles of the carrier diffusion and phonon-drag contributions to the thermopower. The data are well fit by theoretical calculations based on the Boltzmann transport equation and self-consistent modeling of the confinement electrostatics. We discuss the optimization of the power factor and the cooling efficiency in gated silicon nanoribbons. This work is supported by AFOSR, DOE, NSF, and NDSEG.

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