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Anisotropy and boundary scattering in the lattice thermal conductivity of silicon-on-insulator nanomembranes[1] ZLATAN AKSAMIJA, IRENA KNEZEVIC, University of Wisconsin-Madison — Silicon-on-insulator (SOI) membranes and membrane-based nanowires and ribbons show promise for application as efficient thermoelectrics, which requires low thermal conductivity. Thermal conductivity in thin SOI layers, as well as in thin wires and ribbons, is dominated by boundary scattering even at room temperature. Therefore, surface orientation and the direction of heat flow are expected to play a significant role in thermal transport and offer additional control of thermal conductivity in confined systems. In this paper, we demonstrate the sensitivity of the lattice thermal conductivity in thin SOI to the surface crystalline orientation and the direction of heat flow. In this work, we employ a momentum-dependent specularity parameter $p(q)=\exp(-16\pi^3\Delta^2 q^2)$; that allows us to connect the specularity parameter p directly to the rms magnitude (Δ) of surface roughness. Results for 20 nm SOI with different surface and transport orientations show a strong anisotropy due to the directional dependence of both the phonon velocity and boundary scattering rates.

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