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Studying phonon and quasiparticle heating effects on SINIS Coolers THOMAS AREF, HUNG NGUYEN, JUHA MUHONEN, JUKKA PEKOLA, O.V. Lounasmaa Laboratory, Aalto University — A Normal-Insulating-Superconductor (NIS) tunnel junction can function as an electronic cooler. This is typically done in the SINIS configuration where the normal metal island is the object being cooled. By applying proper biasing, the bandgap in the superconductor can be used as an energy filter, allowing hot electrons to escape from the normal island and cold electrons to enter the island from the superconductor. This narrows the Fermi distribution of the electrons on the island, effectively lowering their temperature. By coupling this electronic refrigeration to phonons, the phononic temperature can be reduced as well. These SINIS coolers have potential for replacing other cryogen based refrigeration techniques at low temperatures. One primary aim is to produce an efficient, solid-state, cooling platform that cools small devices from 300 to 100 mK. Our most recent research has helped illuminate various effects that adversely affect the performance of these coolers. Examples of effects probed included geometrical factors, phonon heating, quasiparticle heating, substrate modification, ground planes and direct traps.

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