

Development of an Inductive SINIS Thermometer

Z. Geng and I. J. Maasilta

Nanoscience Center, Department of Physics, University of Jyväskylä, Jyväskylä, Finland

Since Giaever first observed the electron tunneling in Normal metal-Insulator-Superconductor (NIS) junctions in 1960¹, many applications have been developed based on the strong temperature dependence of the current-voltage characteristics of a NIS structure. One promising application is sensitive thermometry by using a symmetrical normal-insulator-superconductor tunnel junction pair, known as a SINIS structure, to measure temperature below 1K.

In this work, we have developed an on-chip inductive readout for SINIS thermometers. Four superconducting multi-turn niobium coils are fabricated near the SINIS junctions and are connected to an $Al - AlO_x - Cu - AlO_x - Al$ SINIS junction thermometer to extract the current signal. This temperature dependent current signal is then picked up inductively by a planar inductor under the input coils, separated by a pin-hole free aluminium oxide insulating layer, and finally read out by a two-stage SQUID preamplifier on the cryostat connected by superconducting wires. By using this method, the current signal can be amplified locally by the “DC transformer” structure at the sub-Kelvin temperature already, and is thus expected to have lower noise level and better temperature sensitivity and resolution compared to a direct room temperature preamplifier readout.

¹Giaever, I. *Phys. Rev. Lett.* **5**, 147-148(1960).