Heat Transport and Thermo-power in a Single-Quantum-Dot Transistor

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We report on the thermo-electricity and the heat transport in a tunnel-contacted and gate-tunable individual single-quantum dot junction, fabricated using the electromigration technique. A pair of hybrid Josephson junctions inserted in the vicinity of the junction enable us to raise and/or monitor the electronic temperature of one of the two leads, the other one being well thermalized to the bath. Using this set-up, we could study the heat dissipation in the quantum-dot junction as a function of both the gate potential and the bias. The data highlights the gate-sensitivity of the thermal conductance through the quantum dot. In the Kondo regime, we report the first measurement of the Seebeck coefficient. This fundamental thermoelectric parameter is obtained by directly monitoring the magnitude of the voltage induced in response to a temperature difference across the junction, while keeping a zero net tunneling current through the device. Striking sign changes of the Seebeck coefficient are induced by varying the temperature, depending on the spin configuration in the quantum dot. The comparison with numerical renormalization group (NRG) calculations demonstrates that the tunneling density of states is generically asymmetric around the Fermi level in the leads, both in the cotunneling and Kondo regimes.