A novel membrane-based nanocalorimeter for studies in superconductivity

S. Tagliati

Dept. of Physics, Stockholm University, AlbaNova University Center, SE-10691 Stockholm, Sweden

Thermodynamic measurements are an important tool to understand fundamental properties of materials. Nanocaloric measurements are suited both to study new physics at mesoscopic scales and to investigate bulk behaviors, like superconductivity, of new classes of materials which may be difficult to synthesize as large crystals. In the past two decades much attention was devoted to studies of high-T_c superconductors and, more recently, of the pnictide superconductors. The electronic specific heat is one of the crucial parameters for the understanding of high-temperature superconductivity, but it is very hard to measure with good absolute accuracy. I will present a high-resolution differential nanocalorimeter developed for accurate thermal measurements of mesoscopic samples, able to detect the electronic contribution to the specific heat with good confidence. The device was specifically designed for applications at low temperatures and high magnetic fields. The calorimeter is based on two free-standing SiN membranes onto which thin-film heaters and temperature sensors are fabricated using standard clean-room techniques. The design allows concurrent use of relaxation and AC steady-state methods. Analytical expressions that describe the properties of an empty cell and the effect of the thermal link between sample and cell are obtained and compared with experiments and numerical simulations with excellent agreement. The features which make this device and our measurement method unique will be discussed.