Thin-film ruthenium microstructures for transition edge sensors

A.S. Ilin, I.A. Cohn, A.N.Vystavkin, A.G. Kovalenko
Kotel'nikov Institute of Radio Engineering and Electronics, Moscow, Russia, ailin@hitech.cplire.ru

The most widely used material for transition edge sensors (TES) working at He-3 cryostats' temperatures is titanium at the moment. The critical temperature T_c for a bulk Ti sample is 0.39-0.45 K, depending on the purity of the material [1]. The main disadvantages of using titanium for thin-film TES are its relatively high chemical reactivity and gettering action. Therefore there is a large spread of superconducting properties of Ti microstructures produced by sputtering and lithography. It is common for the T_c to drop below the working temperature of He-3 cryostats [1]. In this paper we propose ruthenium as a material for said TES.

Ruthenium is substantially inert, and the T_c for bulk Ru samples is 0.49 K [2]. We investigated magnetron sputtered Ru thin films with thickness 13-300 nm on a Si substrate and TES samples based on the thin-film Ru microstructures. It has been found that the T_c for the thin-film TES is 0.55-0.70 K, and the width of the paraconductivity region is 1-5 mK. Furthermore, it was established that lithography process didn't affect the properties of the TES samples, so we were able to get consistant properties for several fabrication sessions. Therefore ruthenium is concluded to be a desirable material for the transition edge sensors.

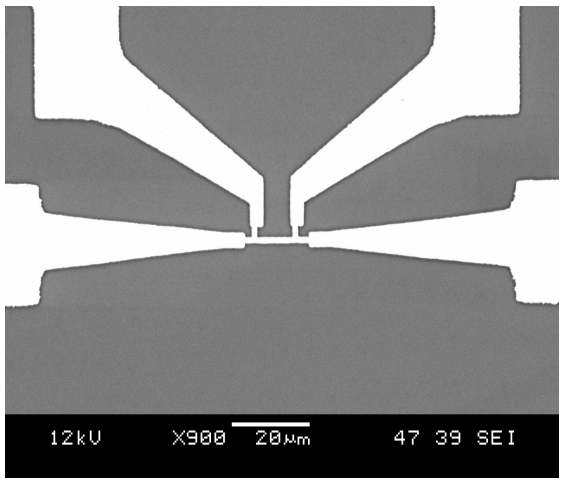

Fig. 1 SEM-picture of the TES sample.

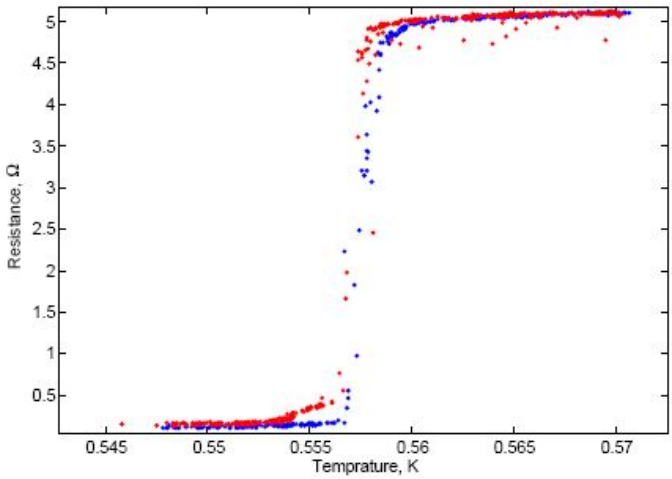

Fig. 2 R(T) characteristic of the TES

1. A. Peruzzi, E. Gottardi, I. Peroni, G. Ponti, G. Ventura. "The influence of impurity concentration and magnetic fields on the superconducting transition of high-purity titanium". Nucl. Phys. B (Proc. Suppl.), **78**, pp. 576-580, 1999.
2. J.K. Hulm and B.B. Goodman. "Superconducting Properties of Rhenium, Ruthenium and Osmium". Phys. Rev., **106**, pp. 659-671, 1957.