Anomalous R-T Characteristics of Superconducting NbN Thin Films

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Abstract. The resistance-versus-temperature curve of superconductors is typically monotonically decreasing at critical temperature T_c. However, some measurements performed on the superconducting NbN layer by the van der Pauw method showed a resistance peak just before T_c which disappeared with the rotation of the contacts. Thus, the 50 nm thick NbN layer was analyzed in detail. The sample was prepared by pulsed laser deposition on a c-cut sapphire substrate with a 50 nm thick AlN buffer layer. Its critical temperature was 13.4 K. The contact rotation led to the critical temperature increase by the peak width to 13.8 K. The anomalous behavior was explained as a result of the superconducting inhomogeneity of the layer since the superconducting granularity could lead to slightly different values of T_c and ΔT_c of the different film sections. Experimentally measured data were fitted by a theoretical model, which enabled the determination of values of T_c and ΔT_c of individual film sections. Furthermore, a perpendicular magnetic field of 6 Tesla led to the minimization of the difference between two contact configurations and to the disappearance of the peak. This result could be a consequence of the global averaging of the order parameter.

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