Superconducting properties of NbN-SiO_2 sol-gel derived thin films

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The electrical properties of disordered and granular materials have been the subject of intensive investigations for decades. Such systems are very interesting from the point of view of the mechanisms of electrical conductivity, relationships between normal and superconducting state and the interplay between local and global superconductivity. This work presents results of superconducting properties studies of xNbN-(100-x)SiO_2 (where x = 80 mol%) films of the thickness from 450 to 1950 nm. The films were prepared by thermal nitridation of sol-gel derived xNb_2O_5-(100-x)SiO_2 coatings. The nitridation process of Nb_2O_5–SiO_2 coatings leads to the formation of weakly disordered structures, with NbN metallic grains dispersed in the matrix of insulating SiO_2. All samples in the normal state exhibit negative temperature coefficient of resistivity. Superconducting transition was not observed for the sample 450 nm thick. To examine the influence of magnetic field on superconducting properties of the films, the resistance versus temperature of 1350 and 1650 nm thick samples was measured in magnetic field up to 7 T. Superconducting transition temperature T_C decreases with the increase of magnetic field. In both samples magnetic field below 2 T influences only the superconducting properties of Josephson junctions between the grains. The magnetic field stronger than 5 T destroys also the superconductivity inside the NbN grains.