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Electrical and structural properties of Tantalum nitride thinfilms near metal-insulator transition LEI YU, RAKESH SINGH, JOHN ROWELL, NATHAN NEWMAN, Dept. of Chemical and Material Engr., Arizona State Univ., LIN GU, Dept. of Physics, Arizona State Univ. — The resistivity of thin-film Ta_xN can be tuned through the metal-insulator (MI) transition by adjusting the nitrogen partial pressure during the reactive sputtering process. Recent study show that NbTiN/Ta_xN/NbTiN structures with Ta_xN tuned in this range can produce Josephson junctions with a high IcRn product and other device parameters required for the next generation of superconductive RSFQ circuits. Despite the practical possibilities, very little is known about transport over the small length scales associated with transversing the barrier. To address this issue, we focus on the transport and structural properties horizontally through NbTiN/Ta_xN/NbTiN structures and transversely across single Ta_xN films for a wide range of Ta_xN thicknesses. When TaxN films are deposited onto oxidized Si wafers, the resistivity (measured in the direction perpendicular to film growth) increases as films become thinner (from 500 nm to 20 nm). Surprisingly, the converse is found for NbTiN/Ta_xN/NbTiN structures. The conductivity of TaxN near the MI transition has temperature dependence of $\sigma(T) = \sigma(0) + AT^n$, common in disordered metallic systems. Our analysis of transport has allowed us to discern the role of percolation transport and the change in material parameter as a function of film thickness.

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