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Tunable Ta_xN Josephson Junctions for Scalable, High Performance, Low Power Computing

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Abstract

Viable alternatives for high performance, low-power dissipation computing has driven increased interest in superconducting electronics research. Although remarkable progress has been made with Nb/Al-AlO_x/Nb Josephson junctions, the necessity for low-temperature processing and the electronic defects associated with AlOx may ultimately limit the ability to scale this technology to the required density. Alternative barriers such as TaN offer a feasible approach to achieve Josephson junctions with suitable I_cR_n product and thermal stability for existing microfabrication processes.

We present results obtained for Josephson junctions with varying Ta_XN composition and thicknesses. A clear dependence of junction behavior on stoichiometry and barrier thickness across a wide range of critical currents and I_cR_n is observed. Conductivity mapping of AlO_x and TaN barriers allows a better understanding of the areal distribution of properties across individual junctions.

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