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Superconductivity and tunneling-junctions in epitaxial Nb2N/AlN/GaN heterojunctions RUSEN YAN, YIMO HAN, GURU KHALSA, SURESH VISHWANATH, Cornell University, SCOTT KATZER, NEERAJ NEPAL, BRIAN DOWNEY, Naval Research Laboratory, DAVID MULLER, Cornell University, DAVID MEYER, Naval Research Laboratory, GRACE XING, DEBDEEP JENA, Cornell University, ECE COLLABORATION, AEP COLLABORATION, MSE COLLABORATION, NRL COLLABORATION — We have discovered that ultrathin highly crystalline Nb2N layers grown epitaxially (by MBE) on SiC [1] and integrated with AlN and GaN heterostructures [2] are high-quality superconductors with transition temperatures from 9-13 K. The out-of-plane critical magnetic fields are found to be ˜14 Tesla range, and the critical current density is 4*1E5 A/cm2 at 5 K. Preliminary in-plane magnetotransport measurements on ˜4 nm thin films indicate a significantly high critical magnetic field exceeding 40 T. Since Nb2N superconducting layers can be epitaxially integrated with GaN, AlN, and AlGaN, we also demonstrate Nb2N superconductivity in a layer located beneath an N-polar GaN high-electron-mobility transistor (HEMT) heterostructure that uses a 2DEG channel as a microwave amplifier; such a demonstration illustrates the potential emergence of a new paradigm where an all-epitaxial III-N/Nb2N platform could serve as the basis for microwave qubits to power quantum computation as well as quantum communications. (1) D. S. Katzer et al., Applied Physics Express 8, 085501 (2015); (2) D. J. Meyer et al., IEEE Transactions on Semiconductor Manufacturing, 29, 384 (2016)

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