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Electron affinity of cubic boron nitride terminated with vanadium-oxide YU YANG, TIANYIN SUN, JOSEPH SHAMMAS, MANPUNEET KAUR, MEI HAO, ROBERT NEMANICH, Arizona State University — H-terminated cubic boron nitride (c-BN) has been shown to exhibit a negative electron affinity (NEA) surface, which may enable applications in thermionic and photon-enhanced energy conversion devices. The ability to withstand high temperature operation is an important factor in the thermionic emission applications. Theoretical and experimental studies have indicated that transition metal oxides can significantly influence the electronic properties of diamond. In this study, a thermally stable NEA for a c-BN surface with vanadium-oxide-termination is achieved, and its electronic structure was analyzed with *in-situ* photoelectron spectroscopy. Thin vanadium layers of ~0.1 and 0.5 nm were deposited on the c-BN surface in an electron beam deposition system. Oxidation of the metal layer was achieved by an oxygen plasma treatment. After 650 ^{o}C thermal annealing, the vanadium oxide on the c-BN surface was determined to be VO_2, and the surfaces were found to be thermally stable, exhibiting an NEA. In comparison, the oxygen-terminated c-BN surface, where B_2O_3 was detected, showed a positive electron affinity (PEA) of ~1.2 eV. The B_2O_3 evidently acts as a negatively charged layer introducing a surface dipole directed into the c-BN. Through the interaction of VO_2 with the B_2O_3 layer, a B-O-V layer structure would contribute a dipole between the O and V layers with the positive side facing vacuum. The lower enthalpy of formation for B_2O_3 is favorable for the formation of the B-O-V layer structure, which provides a thermally stable surface dipole and a NEA surface.

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