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Transport and electronic properties of a polar semiconductor junction[1] M.-H. TSAI, T.-H. LU, National Sun Yat-Sen University — Besides molecular junctions, polar semiconductor junctions may also be suitable candidates for nm-scale electronic active devices. Here, the current density-voltage (J-V) characteristics and partial densities of states (PDOS) have been calculated for an Au/AlN/Au junction with a two-bilayer thick AlN[0001] layer. Results show that when V_{bias}, which is defined as the electric potential at the Al-side electrode relative to that at the N-side electrode, is positive, the J-V curve is approximately ohmic up to $V_{bias} \approx 0.4V$. Then J drops suddenly to a small value. Beyond $V_{bias} \approx 0.4V$, J exhibits approximately three steps at J≈3, 20, 39 nA/a_0^2 in $0.4V < V_{bias} < 0.75V$, $0.75V < V_{bias} < 1.1V$ and $1.1V < V_{bias} < 1.7V$ regions, respectively, within $V_{bias} = 1.7V$ considered in this study. As for $V_{bias} < 0$, the J-V curve is approximately ohmic up to $V_{bias} \approx -2.0V$ and then drops suddenly from about 20nA/a_0^2 down to about 2nA/a_0^2 and remains small beyond $V_{bias} \approx -2.0V$, which indicates a cutoff of the current. Based on calculated V_{bais}-dependent PDOSs, this transport property can be attributed to the energy gap and the polar nature of the AlN layer.

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