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Schottky diode model for non-parabolic dispersion in narrow-gap semiconductor and few-layer graphene YEE SIN ANG, L. K. ANG, M. ZUBAIR, Singapore University of Technology and Design — Despite the fact that the energy dispersions are highly non-parabolic in many Schottky interfaces made up of 2D material, experimental results are often interpreted using the conventional Schottky diode equation which, contradictorily, assumes a parabolic energy dispersion. In this work, the Schottky diode equation is derived for narrow-gap semiconductor and few-layer graphene where the energy dispersions are highly non-parabolic. Based on Kane's non-parabolic band model, we obtained a more general Kane-Schottky scaling relation of $J \propto \left(T^2 + \gamma k_B T^3\right)$ which connects the contrasting $J \propto T^2$ in the conventional Schottky interface and the $J \propto T^3$ scaling in graphene-based Schottky interface via a non-parabolicity parameter, γ. For N-layer graphene of ABC-stacking and of ABA-stacking, the scaling relation follows $J \propto T^{2/N+1}$ and $J \propto T^3$ respectively. Intriguingly, the Richardson constant extracted from the experimental data using an incorrect scaling can differ with the actual value by more than two orders of magnitude. Our results highlights the importance of using the correct scaling relation in order to accurately extract important physical properties, such as the Richardson constant and the Schottky barriers height.

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