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Energy gap states and tunneling currents in semiconducting graphene DOMINIK SZCZESNIAK, Institute of Physics, Jan Dlugosz University, ROSS HOEHN, Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, SABRE KAIS, Department of Chemistry and Physics, Purdue University — It has been predicted that when graphene is supported on a substrate or doped with foreign atom species, the inherent linear electronic dispersion of its pristine form can be strongly altered. Worthy of special attention is the situation when the interactions between graphene and the substrate or dopants lead to an opening of the finite electronic gap in the fermionic spectrum of this nano-material, and strongly influence its transport and optical properties. Herein, the fundamental electronic transport properties of such perturbed graphene are discussed in the framework of the complex band structure analysis, which not only accounts for the propagating but also the evanescent electronic states. Various scenarios responsible for the band gap opening and manipulation of its characteristics are considered, these considerations may entirely account for the aforementioned perturbations to the pristine graphene. It is shown, that the these perturbations are responsible for inducing gap states which allow electrons to directly tunnel between the conduction and valence bands in perturbed graphene. The resulting tunneling states are analyzed in a comprehensive manner, suggesting their great importance for the transport processes across graphene-based semiconducting nanostructures.

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