

Valleytronics in Gapped Graphene: Applications in Quantum Computing / Quantum Communications / FETs

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We review our recent theoretical proposal of quantum valleytronic devices in gapped graphene,[1-4] for potential applications in several frontiers comprising of FETs, quantum computing, and quantum communications. We focus especially on the electrical manipulation of valley pseudospins at the quantum level, and demonstrate the implementation of two quantum devices, namely, 1) valley-based qubits in coupled graphene quantum dots, to build quantum networks consisting of graphene and photons, and 2) valley-based FETs consisting of graphene quantum wires (channels) and armchair graphene nanoribbons (sources and drains), to build low-power FET circuits in graphene. This demonstration indicates that gapped graphene-based valleytronics is an attractive R & D direction in the area of nanoelectronics.

[1] Wu et al., Phys. Rev. B **84**, 195463 (2011).

[2] Wu et al., Phys. Rev. B **86**, 045456 (2012).

[3] Lee et al., Phys. Rev. B **86**, 165411 (2012).

[4] Wu et al., Phys. Rev. B (accepted)