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VOI-based valley filters and valley valves in bilayer graphene quantum wires NING-YUAN LUE, GEORGE YU-SHU WU, Department of Electrical Engineering, National Tsing-Hua University, Hsin-Chu, Taiwan 30013 — Electrons in graphene have an inherent valley degree of freedom called valley pseudospin. Based on the valley-orbit interaction(VOI) in gapped graphene[1], we propose a valley filter/valve in gapped bilayer graphene(BLG)-based quantum wire device, and it's consistent with planar processing and is operated with electric gates producing an in-plane electric field transverse to the wire. The device consists of a quantum wire patterned in BLG by electrical gates, with the vicinity of the quantum wire being oxidized (or implanted with a line of point defects parallel to the wire). The transverse electric field produces a Rashba-type splitting in the valley subbands, and the oxidation (or defects) opens a pseudogap at the point where the two subbands cross. Valley polarization is generated when placing the Fermi level inside the pseudogap. We discuss the pseudogap, the valley polarization, and their dependence on the strength of the electric field and the distance between the oxidized region and the quantum wire. When the electric field is reversed, opposite valley polarity is attained. Therefore, the proposed valley filter can also be put together to form a valley valve. [1] Wu et al., PRB 84, 195463(2011); PRB 88, 125422(2013); Lee et al., PRB 86, 165411(2012).

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