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Mobility Enhancement in Buried Two-Dimensional Electron and Hole Gases by Remote Carrier Screening YI-HSIN SU, KUAN-YU CHOU, YEN CHUANG, Graduate Institute of Electronic Engineering, National Taiwan University, Taipei, Taiwan, PO-YUAN CHIU, NAI-WEN HSU, Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan, TZU-MING LU, Sandia National Laboratories, Albuquerque, NM, US, JIUN-YUN LI, Graduate Institute of Electronic Engineering, National Taiwan University, Taipei, Taiwan —
Buried two-dimensional electron and hole gases (2DEGs and 2DHGs) are a promising platform for solid-state quantum computation. For effective top gating, the surface quality and its impact on the buried two-dimensional carriers are critical. We report a mobility enhancement in the buried Si 2DEG and Ge 2DHG channels due to the remote carrier screening at the surface. An electron or hole screening layer is formed at the surface by carriers tunneling from the buried channel to the surface, resulting in the mobility enhancement. The peak carrier mobilities of Si 2DEG and Ge 2DHG are 4 times and 2 times higher than those without remote surface screening. Furthermore, by increasing the gate voltage, a transition from non-equilibrium to equilibrium in a two-dimensional system due to this surface tunneling is also observed for the first time.

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