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Crossover of Equilibrium and Nonequilibrium Carrier Density in Germanium Two-Dimensional Hole Gases YI-HSIN SU, 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 — We performed a detailed study on the enhancement-mode two-dimensional hole gases (2DHGs) in the $Ge/Ge_{1-x}Si_x$ (0.15 <x <0.4) heterostructures. High mobility of 200,000 cm^2/V-s was achieved with clear quantum Hall plateaus observed. By varying the depth of 2DHG layer, a cross-over of equilibrium and non-equilibrium 2DHG density is reported in any two-dimensional system for the first time. Furthermore, an unexpectedly low effective capacitance in the shallow-channel devices was also observed. Shubnikov-de Haas oscillations showed beatings in a very shallow 2DHG (˜9 nm) due to second subband population.

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