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Surface roughness scattering in multisubband accumulation layers HAN FU, Univ of Minnesota - Twin Cities, KONSTANTIN REICH, Fine Theoretical Physics Institute, University of Minnesota; Ioffe Institute, St Petersburg, BORIS SHKLOVSKII, Fine Theoretical Physics Institute, University of Minnesota
— Accumulation layers with very large concentrations of electrons where many subbands are filled became recently available due to ionic liquid and other new methods of gating. The low temperature mobility in such layers is limited by the surface roughness scattering. However theories of roughness scattering so far dealt only with the small-density single subband two-dimensional electron gas (2DEG). Here we develop a theory of roughness-scattering limited mobility for the multisubband large concentration case. We show that with growing 2D electron concentration n the surface dimensionless conductivity $\sigma/(2e^2/h)$ first decreases as $\propto n^{-6/5}$ and then saturates as $\sim (da_B/\Delta^2) \gg 1$, where d and Δ are the characteristic length and height of the surface roughness, a_B is the effective Bohr radius. This means that in spite of the shrinkage of the 2DEG width and the related increase of the scattering rate, the 2DEG remains a good metal. Thus, there is no re-entrant metal-insulator transition at high concentrations.

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