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Well-width dependence of warm electron relaxation and interface roughness scattering in GaAs/$Ga_{1-x}Al_xAs$ multiple quantum wells

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Abstract: We review our recent results concerning the well-width dependence of the acoustic-phonon-assisted energy relaxation of two-dimensional (2D) warm electrons in modulation-doped GaAs/$Ga_{1-x}Al_xAs$ multiple quantum wells. Electron energy-loss rates via the emission of acoustic phonons are determined from the amplitude of Shubnikov-de Haas (SdH) oscillations, measured as a function of lattice temperature and applied electric field. Experimental results are compared with the existing theoretical models that involve deformation-potential and screened and unscreened piezoelectric scattering. Well-width dependence of the quantum and transport mobilities of 2D electrons in the same samples have also been determined by measuring the quantum oscillations in both the magnetoresistance and Hall resistance. Our results confirm earlier independent conclusions that the momentum relaxation in GaAs/$Ga_{1-x}Al_xAs$ multiple quantum wells is limited mainly by interface roughness scattering. A new theoretical modelling has been proposed and used to estimate the interface roughness parameters from the measured quantum and transport mobilities of 2D electrons.

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