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Measurement of surface charging effects via a buried $Al_{0.24}Ga_{0.76}As/GaAs$ quantum well structure R.D. GANN, M. BIASINI, J.A. YARMOFF, A.P. MILLS, JR., B.C.D. WILLIAMS, UC Riverside, Phys. Dept., L.N. PFEIFFER, K.W. WEST, Bell Lab. Lucent Technologies NJ , X.P.A. GAO, Los Alamos Nat. Lab — We have studied the conductivity of an $Al_{0.24}Ga_{0.76}As/GaAs$ quantum well as a function of the surface charge generated by electron bombardment of the sample in the absence of an externally applied surface electric field. Under a suitable rate of electron irradiation we have been able to completely shut off of the conductive channel, implying a surface density $n = 2.5 \times 10^{11}$el/cm^2. Light illumination quenches the increase of the resistivity, apparently due to photoemission from the metastable surface states. Upon turning off the electron bombardment the conductivity reverses to the original value. We attribute this decay to the electric discharge of the surface. The lifetime ($\tau = 0.30 \pm 0.02$ s.) is almost independent of the conditions of the surface (10 nm of undoped GaAs), which was either bare or covered with $\simeq 100$ layers of xenon and/or water. These findings suggest that electrons are trapped near the surface due to an image potential. The charging efficiency, μ, defined as the ratio of the charge deposited on the surface to the beam current times τ is $\mu_0 \simeq 0.001$. We are now extending this method to investigate surface mobility in other materials, beginning with insulators such as mica. Work supported by:DOD/DARPA/DMEA(grant No.DMEA90-02-2-0216).

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