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Design rules for modulation doped AlAs quantum wells[1] YOON JANG CHUNG, K. W. BALDWIN, K. W. WEST, D. KAMBUROV, M. SHAYEGAN, L. N. PFEIFFER, Princeton Univ — AlxGa1-xAs/AlAs/AlxGa1-xAs quantum wells were grown with various barrier compositions ranging from x=0.26 to x=0.8. We investigate the modulation doping characteristics of the samples by magneto-transport measurements. The carrier concentration in the well peaks near the barrier alloy fraction of x=0.26 in the dark and near x=0.38 after illumination with a red LED. This behavior is consistent with the results in a separate study for AlxGa1-xAs/GaAs/AlxGa1-xAs quantum wells in the range of x=0.26 to x=1.0. We show from a charge transfer model that the calculated energy difference between the conduction band offset at the well interface and the donor energy level, ΔEC-ED, coincides for the two types of wells. This implies that, despite the differing positions of the conduction band minimum for the GaAs and AlAs wells, the doping of either well is governed by the electronic properties of the barrier. Based on this knowledge we designed high quality AlAs quantum wells with low (1 x 10^{11} cm^{-2}) and high (3 x 10^{11} cm^{-2}) density, and the magneto-transport data show clear signals of the fractional quantum Hall effect (2/3, 3/5, 4/7 for low density and 5/3, 8/5 for high density).

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