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Induced magnetic ordering control in a digital (Ga,Mn)As structure JISANG HONG, DINGSHENG WANG, RUQIAN WU, UC Irvine — In our computational studies for Mn/GaAs(110) superlattices, both the thickness of the semiconductor spacers, d, and external carrier density, ρ, are manipulated to observe the trend of ΔE_{FM-AF}, a quantity that describes the effective exchange interaction between two Mn layers. The change in ρ is achieved through variations in a small fraction of electrons in the valence band, accompanied by matching adjustments in positive charge in the semiconductor region. The results indicate that the δ-doped (Ga,Mn)As has a strong FM ground state when d=5.56 Å and d=11.31 Å. The carrier induced AF-FM phase transition occurs in cases with thick spacers. When, d=16.96 Å, for example, the AF configuration is the ground state without external carrier, and is further stabilized by electron doping. In contrast, the FM state gradually prevails in the hole doping side, especially when $\rho > 1.0\times10^{20}/\mathrm{cm}^3$. This clearly explains experimental observations made by Ohno et al, who found that both magnetization and coercive force can be manipulated by applying electric field in the gated structure and changing the carrier (hole) density.

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