Electrical characteristics of magnesium doped GaAs grown by molecular beam epitaxy: Effects of Mg-surface segregation

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We investigated the electrical properties of Mg doped GaAs epitaxial layers with different doping concentrations grown by molecular beam epitaxy (MBE). Hall and capacitance voltage (C-V) measurements were employed to investigate the electrical properties of Mg doped GaAs layers at room temperature. The carrier concentration obtained by Hall measurements at room temperature was decreased from 1.4×10^{19} cm^{-3} to 3.4×10^{16} cm^{-3} with increasing the substrate temperature in the range of 460℃ to 540 ℃. The maximum attainable doping density was N_A-N_D = 1.4×10^{19} cm^{-3}. The Hall hole mobilities of Mg doped GaAs epitaxial layers within the carrier concentration range of $10^{16}<p<10^{19}$ cm^{-3} were 260−6 $cm^2/V\cdot s$. A room temperature C-V doping profile is demonstrated using 1 MHz modulation, which is sensitive enough to resolve the presence of around 0.13~0.16 m highly doped [$3.84\times10^{17}/cm^3$(T_s=485℃), $1.66\times10^{17}/cm^3$(T_s=510℃)] layer formed near the surface. The depth profiles of doping density obtained by C-V measurements show a number of carriers were largely out-diffused toward the surface. It could be attributed to the surface segregation effect, which is predominant in samples with high doping density than those with low doping density.