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Temperature Dependence of the Hole Mobility in GaAsBi

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Abstract: The Hall mobility of holes has been measured in GaAs_{1-x}Bi_x for bismuth concentrations $x=0.94\%$ to 5.5% , in the temperature range 25K to 300K. The hole mobility decreases with increasing bismuth content. At approximately 2% incorporation the mobility is reduced by a factor of 2, which is a smaller reduction than in the case of the electron mobility in dilute gallium arsenide nitride alloys (20x at 1%). The hole mobility of low temperature (T=350C) p-doped GaAs grown with a Bi surfactant was found to be similar to GaAs grown under conventional growth conditions. The temperature dependence of the hole mobility is modeled using a temperature independent term related to bismuth along with terms for scattering from phonons and ionized impurities. From the effect of Bi on the hole mobility in dilute bismide alloys (0.94%) we estimate an isolated Bi atom scattering cross section to be 0.2nm^2 . This is compared to a theoretical value from Fahy et al.[1] of 2.0nm^2 . The scattering cross section of the Bi increases significantly for higher Bi concentrations (5.5%) which we attribute to the effect of the formation of Bi clusters.

[1] S. Fahy, A. Lindsay, and E. P. O'Reilly, IEE Proc., Optoelectron. 151, 352 (2004).