Electrical activation studies of Al$_{0.4}$Ga$_{0.6}$N and Al$_{0.5}$Ga$_{0.5}$N implanted with silicon for n-type doping. ELIZABETH MOORE, YUNG KEE YEO, Air Force Institute of Technology, MEE-YI RYU, Kangwon National University, ROBERT HENGEHOLD, Air Force Institute of Technology — A systematic electrical activation study of Si-implanted Al$_x$Ga$_{1-x}$N with Al concentrations of 40 and 50% grown on sapphire substrates by MEMOCVD has been made as a function of ion dose and anneal temperature. The silicon ions were implanted at 200 keV with doses from 1x10$^{14}$ to 1x10$^{15}$ cm$^{-2}$ at room temperature. The samples were proximity cap annealed from 1150 to 1350 °C for 20 minutes in a nitrogen environment. Hall-effect measurements were made from 10 to 700 K and cathodoluminescence measurements were taken at 7 K. Electrical activations of nearly 100% were obtained for the Al$_{0.4}$Ga$_{0.6}$N:Si after annealing at 1350 °C for 20 minutes for doses of 1x10$^{14}$ and 5x10$^{14}$ cm$^{-2}$ and after annealing at 1200 °C for 20 minutes for the dose of 1x10$^{15}$ cm$^{-2}$. The Al$_{0.5}$Ga$_{0.5}$N:Si also had high activations of nearly 100% for the two lower doses after annealing at 1300 °C for 20 minutes, while for a dose of 1x10$^{15}$ cm$^{-2}$, an activation of 66% was obtained after the same annealing treatment. The highest room temperature mobility for the Al$_{0.4}$Ga$_{0.6}$N and Al$_{0.5}$Ga$_{0.5}$N samples are 61 and 55 cm$^2$/V·s, respectively for the samples annealed at 1350 °C for 20 minutes. CL spectra support the electrical results in determining the optimal annealing conditions.

Elizabeth Moore
Air Force Institute of Technology

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