Digest of Tech. Papers The 8th Conf. (1976 International) on Solid State Devices, Tokyo

B-5-1
(INVITED)

Preparation and Properties of GaAs Devices by Molecular Beam Epitaxy

A. Y. Cho
Bell Laboratories
Murray Hill, New Jersey 07974, U.S.A.

The deposition of layers from molecular beams has potential in the field of semiconductor processing technology. The ability to grow layers with precise thickness and doping profiles is the advantage of molecular beam epitaxy (MBE). Layers of GaAs and $A\ell_xGa_{1-x}As$ as thin as about 100 Å to as thick as 10 μm over a wafer dimension of 2.5 cm × 2.5 cm have been prepared. The unintentionally doped layers have a carrier concentration of $2\times10^{14}/cm^3$ and they are p-type. Tin is the best n-type dopant for GaAs which gives a room temperature mobility as high as 7600 cm^2/V sec at a concentration $2\times10^{15}/cm^3$. Photoluminescence studies showed that the luminescent intensities of Sn-doped GaAs layers grown by MBE were greater than those grown by liquid phase epitaxy (LPE) while the $A\ell_xGa_{1-x}As$ layers grown by MBE are presently still inferior to those grown by LPE.

Microwave devices such as Varactor, IMPATT, mixer diode, and FET's were prepared with MBE. Within the last year, a dramatic improvement in the performance of the lasers led to the first continuous operation of GaAs-$A\ell_xGa_{1-x}As$ DH lasers at a temperature as high as 100°C. Lateral current confinement was achieved in injection lasers with embedded stripes selectively grown by MBE. Single transverse mode was obtained at current 4 to 6 times threshold with a 5 μm wide stripe. More recently, GaAs-$A\ell_xGa_{1-x}As$ DH lasers were successfully taper coupled to integrated low-loss passive waveguides. Optical losses in the $A\ell_{0.25}Ga_{0.75}As$ waveguides between 1.1 eV and 1.4 eV are less than 1.5 cm^{-1}.