Temperature and Well-Width Dependence of Photoluminescence Transitions in an ALGAAS/GAAS MQW sample

The heavy and light hole transitions of an MBE (Molecular-Beam-Epitaxy) grown Al (0.3) Ga (0.7) As / GaAs MQW (Multiple Quantum Well) sample were investigated over a temperature range of 20-300 K using the technique of photoluminescence. The MQW sample contained GaAs wells of widths 47 Å, 70 Å, 93 Å, 117 Å and 140 Å sandwiched between AlGaAs barriers of >500Å. Because the bandgap of GaAs (1.4 eV) is less than that of the AlGaAs (1.8 eV), the electron-hole recombinations take place almost entirely within the one-dimensional quantum wells formed by the narrow layers of GaAs. The MQW sample was illuminated with the 4880 Å line of an Argon-Ion Laser with an incident power at the sample surface of approximately 20mW. The sample was mounted on a cold head and its temperature controlled with a closed-cycle Leybold helium refrigeration system and monitored by a Lakeshore platinum resistor. The photoluminescence spectra were collected using an automated single grating (1200 grooves/mm) Triax 550 spectrometer equipped with a GaAs PMT (photo-multiplier tube) and controlled with LabView data acquisition software. The temperature dependence of all transition energies were found to closely follow the conventional GaAs empirical equation for temperature dependence. In addition, the transition energies appropriately scaled as the inverse square of the well-width, as predicted from one-dimensional quantum mechanical theory, except for slight departure at very narrow well widths.