DIRECT MEASUREMENT OF CONFINED ELECTRON STATES IN HIGHLY-UNIFORM CARBON-DOPED GAAS QUANTUM DOTS

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Abstract

We demonstrate a novel p-type GaAs/AlGaAs quantum dots (QDs) structure. The recombination between confined electrons and photo-excited holes bound to carbon acceptors has numerous advantages for directly investigating the novel physical phenomena in semiconductor nanostructures. Since the bound-hole energy is very well defined, photoluminescence (PL) is a direct measurement of the energy spectrum of the confined electron states, and localisation of the hole relaxes k-conservation rules such that the entire electronic density of states can be understood. This approach was used very successfully by Kukushkin to probe the physics of two-dimensional electron systems, leading to optical observation of Landau levels, Shubnikov-de Haas oscillations, the fractional quantum Hall effect and Wigner crystallisation. However, despite the intense interest in the physics and applications of low-dimensional semiconductors, there is no equivalent work involving zero-dimensional (quantum-dot) structures. Our novel zero-dimensional electron system comprises highly-uniform GaAs/AlGaAs quantum dots with carbon acceptors embedded in a 100-period GaAs/AlAs superlattice structure, grown by molecular beam epitaxy using the droplet epitaxy approach.

Keywords: Carbon-doped, GaAs, quantum dot, acceptor

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