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Materials Science : Optical and Electronic Materials

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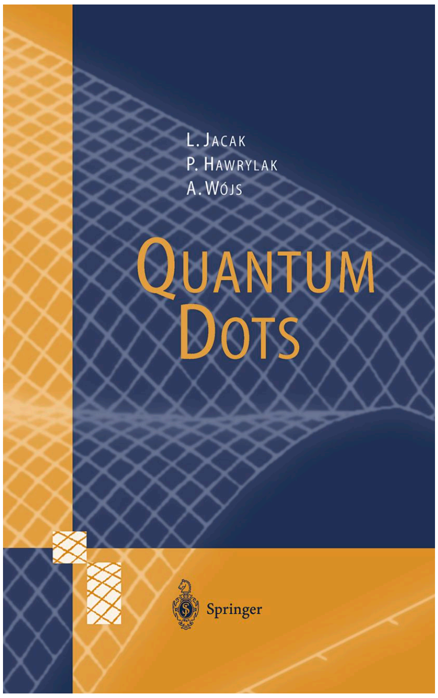
Quantum Dots

- **Concentrates on: one-particle properties, many-electron dot, probing of a dot with tunneling, FIR, PL**
- **Comparison of band-structure and effective-mass-method based models**

We present an overview of the theoretical background and experimental re- sults in the rapidly developing field of semiconductor quantum dots - systems 8 6 of dimensions as small as 10- -10- m (quasi-zero-dimensional) that contain a small and controllable number (1-1000) of electrons. The electronic structure of quantum dots, including the energy quan- tization of the single-particle states (due to spatial confinement) and the evolution of these (Fock-Darwin) states in an increasing external magnetic field, is described. The properties of many-electron systems confined in a dot are also studied. This includes the separation of the center-of-mass mo- tion for the parabolic confining potential (and hence the insensitivity of the transitions under far infrared radiation to the Coulomb interactions and the number of particles - the generalized Kohn theorem) and the effects due to Coulomb interactions (formation of the incompressible magic states at high magnetic fields and their relation to composite jermions), and finally the spin-orbit interactions. In addition, the excitonic properties of quantum dots are discussed, including the energy levels and the spectral function of a single exciton, the relaxation of confined carriers, the metastable states and their effect on the photoluminescence spectrum, the interaction of an exciton with carriers, and exciton condensation. The theoretical part of this work, which is based largely on original re- sults obtained by the authors, has been supplemented with descriptions of various methods of creating quantum-dot structures.



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