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A meshless k·p method for analyzing electronic structures of quantum dots

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Despite of their merits such as *ab initio* feature or applicability in the full momentum range, modeling methods like first principles, tight binding, etc., often encounter a great challenge for dealing with low dimensional systems with a big compilation of atoms, e.g. quantum dots (QD). A multiband k-p method is effective for modeling electronic structures at low k, which however is good enough for discussion of optoelectronic properties. Numerical implementation such as the finite difference method and the finite element method is inefficient and tedious for QDs, because of the numerical process for differentiation or integration which relies on 3D-space meshing. In this talk, the Fourier transform-based k-p method (FTM), which formulates both Hamiltonian matrix and envelope functions will be presented, and thus solves the k-p equations in momentum space. In mathematical nature, Fourier transform linearizes the differential equations, and thus removes the demand for any numerical process that requires 3D-space meshing. The FTM demonstrates an advantage on controlling spurious solutions due to its inborn cut-off process, whereas incorporation of Burt-Foreman operator ordering further enhances the merit. Also as a byproduct, the meshless process favors the investigation that needs to change structural parameters. The author studied the truncated pyramidal QD by varying the truncation factor. Both the kinetic part and the strain have been incorporated in the Hamiltonian equation.

Biography

Ting Mei has completed his PhD from National University of Singapore. He worked in School of Electrical and Electronic Engineering, Nanyang Technological University as Assistant Professor and Associate Professor in 2000-2010, and in Institute of Optoelectronic Materials and Technology, South China Normal University as the Director and Chair Professor in 2009-2013. He is presently a Professor in School of Science, Northwestern Polytechnical University. He is a senior member of IEEE and has published more than 100 papers in refereed journals. He served as Vice Chairman (2004, 2005) and committee member (2009) of IEEE Photonics Society/LEOS chapter, Singapore section, and one of the conference chairs of the 2nd Advances in Optoelectronics and Micro/Nano-optics (AOM 2010) in Guangzhou, China.

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