BEND-IMITATING THEORY AND ELECTRON SCATTERING IN SHARPLY-BENT QUANTUM NANOWIRES

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S u m m a r y

The concept of bend-imitating description as applied to the one-electron quantum mechanics in sharply-bent ideal electron waveguides and its development into a self-consistent theory are presented. In general, the theory allows one to model each particular circular-like bend of a continuous quantum wire as some specific multichannel scatterer being point-like in the longitudinal direction. In an equivalent formulation, the theory gives rise to rather simple matching rules for the electron wave function and its longitudinal derivative affecting only the straight parts of a wire and thereby permitting one to bypass a detailed quantum mechanical consideration of elbow domains. The proposed technique is applicable to the analytical investigation of spectral and transport properties related to the ideal sharply-bent 3D wire-like structures of fixed cross-section and is adaptable to the 2D wire-like structures, as well as to the wire-like structures in the magnetic field perpendicular to the wire bending plane.

In the framework of bend-imitating approach, the investigation of the electron scattering in a doubly-bent 2D quantum wire with S-like bend has been made, and the explicit dependences of the transmission and reflection coefficients on geometrical parameters of a structure, as well as on the electron energy, have been obtained.

The total elimination of the mixing between the scattering channels of a S-like bent quantum wire is predicted.