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Charge transfer in nanostructures for solar energy and biochemical detector applications

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Semiconductor heterostructures, such as nanowires, quantum dots and rings are, due to their unique properties, of potential interest for development of new nanodevices. For instance quantum dots in the strong quantum confinement regime exhibit size tunable bandgaps, large absorption cross sections, and multiple exciton generation, which can be exploited to improve photovoltaic conversion efficiency or detector selectivity. Optoelectrical properties of these nanostructures, their application in biochemical detectors, and processes important for detectors selectivity and sensitivity, interaction of light and nanostructures, and charge tunneling between nanostructures will be discussed. The effect of violation of symmetry of QD geometry on the tunneling is studied in details. We show that small violation of QD geometry drastically affects localization of electron and leads to relaxation of delocalized state of the system. Also considered will be the effect of electric field (applied to double QD system) as another factor that violates the QD symmetry. We show that electric field makes the same effect on "delocalized" electron wave function as the geometrical violation of the symmetry. We conclude that the symmetry violation in QDs reduces electron transport through the system, which may impact nanodevice performance. Additionally we consider double quantum rings (DQR) as a particular case of double quantum dot system. The anti-crossing of the levels as the mechanism of localized-delocalized tunneling is clearlyan important element in QDR, which can be utilized to achieve stable quantum qubits states.

Biography

Branislav Vlahovic is Director of the National Science Foundation Computational Center of Research Excellence and Director of the NASA University Research Center for Aerospace Device at North Carolina Central University. In 2004, he was awarded by the Board of Governors of The University of North Carolina Oliver Max Garden statewide award for his research and contribution to science. He has published more than 250 papers in peer reviewed journals.

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