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## Optical sensing for dynamics of the localized/delocalized states in binary quantum systems

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Weakly coupled binary nano-sized systems demonstrate perspectives for nano-sensor applications. We study electron/hole localization and spectral distributions of localized/delocalized states in binary InAs/GaAs quantum complexes, including quantum wells (QWs) and quantum dots (QDs). The InAs/GaAs heterostructures are described using the effective potential model. It was shown, that the electron tunneling and spectral distributions of localized/delocalized states in binary system is extremely sensitive on shape symmetry violations. The parameter  $\Theta$ , which defines delocalized ( $\Theta \approx \pi/2$ ) or localized ( $\Theta \approx 0$ ) states of an electron, depends on the energy difference  $\Delta$  of the spectra in left and right QDs. The difference can be caused by a shape symmetry violation. The sensitivity of the parameter  $\Theta$  to the small variations of  $\Delta$  is estimated as  $\frac{\partial \Theta}{\partial \Delta} \approx \frac{1}{2\Delta}$ . This work focuses on the optical registration of the localized/delocalized states dynamics. Modeling of carrier transfer from a barrier in InAs/GaAs dot-well, tunnel-injection structure is performed. In Fig 1, shown is the electron wave functions of the localized and delocalized states calculated for two spectral levels:  $E=0.345$  eV and  $E=0.444$  eV, respectively. The energy of the delocalized state corresponds to that one for which the tunneling between dot and well occurs. The relation to the PL experiments for such complexes is provided. We model the second pick of the PL spectrum, which corresponds to the carriers tunneling in the dot-well complex, in the terms of the localized/delocalized states. Influence of the variations of geometrical parameters of QD and QW on the tunneling will be presented.

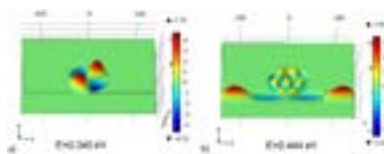


Figure 1. The electron wave functions of the (a) localized and (b) delocalized states in the InGaAs/GaAs dot-well binary complex.

### Biography

Branislav Vlahovic is Director of the National Science Foundation Computational Center of Research Excellence, NASA University Research Center for Aerospace Device, and NSF Center Partnership for Research and Education in Materials at North Carolina Central University. In 2004, he was awarded by the Board of Governors of The University System of North Carolina Oliver Max Gardner statewide award for his research and contribution to science. He has published more than 300 papers in peer-reviewed journals. His research interest includes pulsed laser deposition of nanostructures, nonlinear optics, computer simulations of nanostructures, tunneling and charge transfer between nanostructures, detectors and devices based on quantum confinement, nanophotonics, semiconductor structures and photovoltaics.

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