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High sensitivity and selectivity biochemical sensor based on quantum confinement

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Abstract

Presented will be highly sensitive, target specific biochemical sensor based on the well understood phenomenon of charge tunneling between two quantum confined systems. Its operation relays on the matching of electron density of states in the detector nanostructure (for instance quantum dots (QDs), nanowires, nanotubes) and the density of states in the target molecule (to be detected). The fundamental mechanism behind this device design is that efficient charge transfer will occur only between a detector nanostructure and a target molecule with matching density of states distribution. This new approach to biochemical sensing is unique. Theoretically, this type of sensor is much more selective in detecting biochemical agents than sensors based on changes in conductivity, which is the case for most current sensors. The signal from a device based on charge tunneling, e.g. a change in capacitance, will occur only if a specific molecule, with specific energy levels is present next to a detector nanostructure with matching energy levels. Changes in conductivity in conventional sensors, however, can be affected by many other molecules, even those that are very different in structure.

Discussed will be realization of the desired density of states distribution (to be the same as in the molecule that will be detected) in the nanostructure, for instance QD, through nanostructure size, shape, composition, and external parameters, as for instance pressure, and voltage. Considered will be other effects important for sensor performance, including tunneling and charge transfer between nanostructures and chaotic charge nanostructure behavior.

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.