The main objective of the current study is to demonstrate the implementation of advanced simulation models providing a proper description of electric responses in nanosensing systems [1]. Initially, we consider physical nanosensors (pressure and temperature) based on functionalized CNTs and GNRs nanostructures. The model of nanocomposite materials based on carbon nanocluster suspension (CNTs and GNRs) in dielectric polymer environments (e.g., epoxy resins) is regarded as a disordered system of fragments of nanocarbon inclusions with different morphologies (chirality and geometry) in relation to a high electrical conductivity in a continuous dielectric environment. The electrical conductivity of a nanocomposite material depends on the concentration of nanocarbon inclusions (in fact, carbon macromolecules). Various nanocomposite morphologies are considered and computer simulation results are discussed [2].

Secondly, we pay attention to the development of bionanosensors based on polymer nanoporous structures (nanotacks) with various enzymes, which provide corresponding biocatalytic reactions and give reliably controlled ion currents [3,4]. In particular, we describe a concept for a glucose biosensor based on the enzyme glucose oxidase covalently linked to nanopores of etched nuclear track membranes. This device can be used to detect physiologically relevant glucose concentrations. The sensitive catalytic sensor can be made re-usable due to the production of diffusible products from the oxidative biomolecular recognition event.