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Slava V. Rotkin 先生講演会
(Pennsylvania State University)

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Nanotube based materials: Symmetry breaking and optical properties

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Materials physics of hybrid organic-inorganic biomaterials is very rich. In this talk I consider a well-known example: stable hybrids of single-wall carbon nanotubes (NTs) to nucleic acid (NA) oligomers. I will discuss theoretical and experimental results for DNA:NT complexes, and interactions of those with other materials and living cells. I will start with formation and photophysics of DNA:NT complexes. The DNA was known to change the NT infra-red (IR) photoluminescence response. This response is within the IR optical (water) window of tissues and, given these hybrid materials are fully biocompatible (at low concentrations, to be discussed), multiple biological applications can be foreseen for in vivo sensing.

At the same time DNA functionalization could allow efficient delivery across cellular membrane and biochemical specificity. The latter has been already used to identify biomechanical response of NT inside the stem cells, along with using NT Raman signals for imaging. We were able to achieve long-term cellular studies of neural stem cells using such Raman signals.

If time allows, I will touch upon interaction of NT:DNA with rare earth ions (REI). Potential attractiveness of REIs for bio-sensing motivated us to explore optical properties of their complexes with carbon single-wall nanotubes. REI/DNA/SWNT solutions show FRET and non-trivial photoluminescence behavior in a silicagel matrix. When bound to SWNTs, ions may induce changes in the nanotube bandstructure, including exciton localization on an ion site. Similar effect may be expected from the DNA, ionized in solution. Finally, I will show how the UV absorption in DNA, is followed by ionization of certain nucleobases into the NT bands, thus saving the NA from irradiation damage.

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