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Applications of carbon nanomaterials in biological imaging and drug delivery

Abstract:

The complexity of cancer conditions known to date needs to be addressed with therapeutic strategies performing multiple functions: drug delivery, molecular imaging tracing drug delivery pathways and biological sensing of cancer environments. We develop nanomaterials-based platforms for such multifunctional image-guided drug/gene therapies. Single-walled carbon nanotubes (SWCNTs) are used as one-dimensional carriers for anti-inflammatory siRNA and anti-fibrotic PX-866 drug delivery to liver intended to mitigate the effects of nonalcoholic steatohepatitis and prevent its potential translation into hepatocellular carcinoma. SWCNTs exhibit type-specific emission in the near-IR water window with reduced biological autofluorescence and high tissue penetration depth. In our work different SWCNT types are complexed to specific combination treatment drugs or genes to separately assess the therapeutic effect and the delivery pathways of each therapeutic. Glucose-based quantum dots (GQDs) are developed in this work as an alternative zero-dimensional fully multifunctional platform providing dual color imaging and sensing of cancer environments. GQDs are specifically designed as biocompatible materials emitting fluorescence both in the visible (with up to 60% quantum yield) and near-infrared that can be potentially used for *in-vitro* and *in-vivo* detection respectively. pH-sensitivity of the emission allows for optical detection of cancer environments combining the essential optical diagnostic functions in one simplistic glucose-derived platform.

Biography:

Dr. Naumov received his B.S. in Physics from the University of Tennessee, Knoxville, where he started his nanotechnology research working on separation of chiral carbon nanotubes. He received his M.S. and Ph.D in Applied Physics from Rice University, where his research was focused on optical properties of carbon nanotubes and graphene. He continued as a Research Scientist at Ensysce Biosciences Inc. with complimentary Postdoctoral appointment at Rice University, working on the development of nanomaterials-assisted cancer therapeutics. Later on he joined Central Connecticut State University as an Assistant Professor. There he has further explored applications of nanomaterials in biophysics and optoelectronics. In 2015 Dr. Naumov has joined TCU, where he continues his work in applied biophysics and nanotechnology.