



BioSystems Science and Engineering

SEMINAR

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CES Seminar Hall

DNA based emerging technologies for biological and biomedical applications

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Structural DNA nanotechnology explores various nanoscale structural and functional properties of DNA to manipulate matter at nanoscale for diverse applications.¹ Three dimensional architectures based on DNA polyhedra have raised particular interest in biomedical applications.^{2,3} I will present the first successful delivery of quantum dots (QDs) as the internal payload of DNA icosahedra. A long-standing challenge for QDs has been the inability to achieve their monofunctionalization in bulk. We resolve this by encapsulating QDs within molecularly identical icosahedral DNA particles in bulk where the DNA shell is monofunctionalized with different endocytic ligands. We demonstrate the monofunctionalization and successful specific, endocytic uptake of QDs, using multiple endocytic ligands like folic acid, Galectin-3 (Gal3) and Shiga toxin B-subunit (STxB).⁴ Single particle tracking of Gal3/STxB-bearing, QD-loaded icosahedra using Lattice Light Sheet Microscopy reveal new observations of compartment dynamics along the endocytic pathways. QD-loaded DNA polyhedra bearing ligands of unique stoichiometry represent a new class of high-precision molecular imaging tools for quantitative approaches to complex biological phenomena arising from receptor clustering.⁵ My results highlight the emerging potential of DNA devices in cell biology and biomedical applications that could enable probing and programming various biological systems as well as developing next generation tools for targeted delivery of molecular payloads within living systems.

About the Speaker

Dhiraj did his Bachelors and Masters in Chemistry from University of Pune in 2005 and 7 respectively bagging gold medal for BSc and rank 1 for both BSc and MSc. Dhiraj was more interested in out of the test tube applications of small molecules that chemists were tirelessly synthesizing. For this, he landed in the lab of Yamuna Krishnan for PhD in Chemical Biology of nucleic acids. He completed his PhD in 2013 bagging the outstanding thesis awards from GoI and high impact scientific publications. He continued his research in cell biology using DNA nanotechnology for his postdoc by securing the Curie Postdoctoral fellowship in 2013 to work in another exciting field of chemical biology of membranes and endocytic delivery with Ludger Johannes at Curie Institute, Paris. He also received Human Frontiers HFSP fellowship in 2014 and multiple other opportunities like to attend Lindau Nobel Laureates meeting in Germany and France Advanced Bioimaging Workshops. Currently He is working as Human frontiers postdoctoral fellow at Institute Curie in Paris where he is exploring the potential of DNA nanotechnology as tools for advanced bioimaging as well as for biomedical applications.