

SYMoCADS

GUEST LECTURE

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BIONANOMACHINE DIAGNOSTICS AND NANONETWORK THERAPEUTICS: NEXT GENERATION CANCER MANAGEMENT WITH BIONANODEVICE INTERFACES

ABSTRACT

Molecular Communication is evolving as a supradiscipline of bioinspired Information and Communication Technologies. The next breakthroughs in Molecular Communication greatly depends on the deep understanding of complex diseases, epitomized by brain malignancies. This is being achieved by delineating underlying cellular and sub-cellular processes in the context of interactive bionanomachines and their comprehensive management with diagnostic and therapeutic interventions, controlled externally. Herein, we present our recent progress in the fields of Externally Controllable Molecular Communication and brain malignancies, aiming towards drastic transformation in the way we diagnose and treat such disorders as well as other multifactorial brain pathologies. Inmessaging signals delivered to actuators are converted to tumour cell reprogramming by genetically engineered transducers representing cell and exosome bionanomachines. Evolving changes in tumour abundance and phenotype are detected by cell-based sensors and tumour alterations are translated to optical signals communicated via outmessaging to machine learning-enabled controllers, which regulate the function of the actuating system. Promising recent data involve targeting cell- and exosome-mediated theranostic systems as well as phenotypic switching and network formation, within close-loop multimodal and multifunctional systems. With the aim to transform Externally Controllable Molecular Communication from a theoretical concept to a clinically applicable technology, we identify gaps and challenges and share our views and thoughts on how advancements in diagnostics and therapeutics based on bionanomachine, nanonetwork and bionanodevice interfaces can bring a paradigm shift in the way we manage malignant diseases and other complex disorders.

ANDREANI ODYSSEOS, Medical and Molecular Oncologist, a member of the Harvard Club of Cyprus and co-founder and Research Director of EPOS-lasis, R&D, leads revolutionary translational research in nano-biotechnology, externally controllable molecular communications for cancer sensing and therapy including wearable and implantable devices, supporting the evolution of clinically applicable Digital Twins and Internet of BioThings. She is a Graduate of Athens Medical School; research and clinical post-doctoral studies at Dana – Farber Cancer Institute and Fred-Hutchinson Cancer Research Center; 1st Price recipient of CyEC, established a vibrant SME for cell therapies and hybrid Nano-theranostics. Dr Odysseos has attracted funding amassing € ~7.5M, including MSCAs, IMI, R&I Actions and three most prestigious EIC *Pathfinder* grants. Her findings in Optical Biosensing Interfaces and Targeted Nano-therapeutics are secured in 8 patents (5US, 2EPO, 1WIPO) and is published in peer-reviewed papers, book chapters and monographs. She has been a co-founder of the European Federation of Biotechnology -Section of Medicines Development and the EUREKA Cluster on New Safe Medicines Faster. Her work integrating biomedical sciences, biomedical engineering and artificial intelligence, contributing to clinically applicable emerging technologies for the management of cancer and neurodegenerative disorders has been acknowledged with an honorary membership by the International Academy for Medical Education (IAMED).