

# 16<sup>TH</sup> WORLD MEDICAL NANOTECHNOLOGY CONGRESS September 03-04, 2018 Tokyo, Japan

## Single-walled carbon nanotubes as sensors of reactive species: Potential therapeutic implications

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Reactive species, specifically Nitric Oxide (NO) and Hydrogen Peroxide ( $H_2O_2$ ) activate signal transduction pathways during angiogenesis and other biological systems and therefore play important roles in physiological development as well as various patho-physiologies. Herein, we utilize a near-infrared fluorescent Single-Walled Carbon Nanotube (SWNT) sensor array to measure the single-molecule efflux of NO and  $H_2O_2$  from Human Umbilical Vein Endothelial Cells (HUVEC) and cancer cells in response to angiogenic stimulation or chemotherapeutic drugs. The nano-sensor array consists of a SWNT embedded within a collagen matrix that exhibits high selectivity and sensitivity to single molecules of specific reactive species. We observed that the production of  $H_2O_2$  following VEGF stimulation is elevated outside of HUVEC, but not for stimulation via nano-rods, while increased generation is observed in the cytoplasm for both cases, suggesting two distinct signaling pathways. In addition, we are able to detect the spatial resolution of NO in HUVEC cells in response to VEGF. Moreover, by employing transmission electron microscopy, confocal fluorescent microscopy and UV-Vis spectroscopic analysis, we have confirmed the internalization of DNA-SWCNT in HUVECs. Additionally, by using pharmacological inhibitors as well as genetic approaches, we have found that SWCNT is endocytosed through Rac1-GTPase mediated macro-pinocytosis in normal endothelial cells. Our work reveals a unique mode of entry of SWCNT in cells and might help to properly formulate SWCNT as nano-vectors in biological systems. Moreover, the SWNT platform can be employed for early detection and therapeutic intervention of patients from liquid biopsies, this topic will be discussed as well.

### Biography

Debabrata Mukhopadhyay is a Professor of Biochemistry and Molecular Biology, Mayo Clinic School of Medicine and Science, Jacksonville, Florida. He has his specific expertise in key research areas including cancer, cardiovascular diseases, neurodegenerative diseases and diabetes. As a Postdoctoral Fellow and later as an Associate Professor at Harvard Medical School, Boston, he carried out angiogenesis and tumor microenvironment related research. He has been serving as a Reviewer for several study sections in NIH, Department of Defense and also international funding agencies and participating as Editorial Board Member for several distinguish journals. Recently, he has been appointed as the Florida Department of Health Cancer Research Chair to develop a new Mayo clinic translational nanomedicine center. He has published more than 198 peer-reviewed manuscripts in different journals including Nature, Nature Medicine, Cancer Cell, Cancer Research, Nanoletters and other highly rated journals.

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