COLLEGE OF ENGINEERING
MECHANICAL ENGINEERING
UNIVERSITY OF MICHIGAN

ME Department Seminar

Bioelectric Effects in Tissues and Cells

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Abstract

This presentation will focus on recent developments in the use of electric fields and currents in controlling cell migration, mitigating bacterial biofilms, and distinguishing between different tissue types. These processes are important in many physiologically relevant situations such as cancer metastasis, healing of wounds, remediation of antibiotic-resistant bacterial biofilms, and cancer detection and imaging. By considering biological tissue as electrical elements with resistance, capacitance, and negligible inductance, traditional approaches have missed some subtle effects. Existing methods for studying cell migration *in vitro*, for example, rely on driving a current through the medium containing the cells typically with electrodes either directly or indirectly in contact with the medium containing cells, with electric field strengths ~ 1 V/cm. How cells sense and actually respond to externally applied electric fields and currents is unknown and a topic of present research. This presentation will explore the use of non-contact, inductive methods of applying electric fields as well as contact methods that apply electric fields without current flow. New results from these inductively applied electric fields show surprising biological effects at field strengths ~ μV/cm and even in the absence of current flow, and challenge current understanding of bioelectric effects in mammalian systems and bacteria. The presentation will conclude with the implications of bioelectric effects for clinical applications.

Bio

Vish Subramaniam is currently Professor and Chair of the Department of Mechanical & Aerospace Engineering and Professor in the Chemical Physics Program at Ohio State University. He earned his B.S. and M.S. degrees in Mechanical Engineering from Columbia University, and his Ph.D. in Mechanical Engineering from Carnegie Mellon University. His present research is in the area of biophysics and focused on the interaction between low-frequency electromagnetic fields and tissues and cells. The applications of his research span hindering cancer metastasis, accelerating wound healing, destroying antibiotic-resistant bacterial biofilms, cancer detection and imaging, and non-invasive detection of malaria. He has previously contributed to space plasma propulsion, synthesis of novel materials such as diamond and single-walled carbon nanotubes, plasma-shock interactions, and non-equilibrium plasma and gas dynamics.