FIU | **Seminar Experience**

ELECTRICAL & COMPUTER ENGINEERING

Friday, September 19 **FIU Engineering Center**

10:00—11:00 am **EC Room # 1107**

www.ece.fiu.edu

"Electrical Methods for Delivering Drugs and DNA in Vivo for Therapeutic Purposes"

Mark Jaroszeski, Ph.D.

University of South Florida

Associate Professor, Department of Chemical and Biomedical Engineering

ABSTRACT

The use direct current (DC) pulses in the body to facilitate cellular uptake of exogenous molecules, such as drugs and DNA, that do not normally penetrate the plasma membrane was first demonstrated *in vivo* about 25 years ago. Today, there are over 85 active and completed clinical trials in the US that have utilized the delivery technology. Through work in animal models and in cell cultures, it is now understood that the application of DC pulses induces a dielectric breakdown of the exterior cell membrane. This breakdown results in temporary defects, electropores, in the membrane that that reseal due to the self-assembling nature of the phospholipids that comprise the membrane. Resealing takes about 20 minutes. During this time exogenous molecules that normally do not cross the cell membrane can be transported into the cells.

This delivery method, known as electroporation, is typically carried out by first injecting the molecule of interest into the tissue. Then, DC pulses are applied locally to the injected volume of tissue. When a cell is in an electroporated state, small exogenous molecules such as drugs are free to diffuse into the cells. The exact mechanism of DNA transport into cells has not yet been elucidated, but is absolutely a result of the applied of DC pulses. The applications of this technology are significant with respect to treating many different types of cancer by delivering drugs. The applications are vast with respect to delivering DNA for vaccination, cancer immunotherapies, and alleviating metabolic diseases. Examples of each of these electroporation-based delivery scenarios will be presented in detail as they involve developed tissue specific electrodes, pulsing protocols, and delivered molecules.

BIOGRAPHY

Dr. Jaroszeski holds MSChE. and BSChE degrees and received a Ph.D. in Engineering Science in 1993 from the University of South Florida. From 1993 until 2002 he was a Research Assistant Professor in the USF Dept. of Surgery. Currently he is an Associate Professor of Chemical & Biomedical Engineering. Dr. Jaroszeski's primary research interest is physical methods for *in vivo* drug and gene delivery and biomedical instrumentation. The bulk of his research work has focused, more specifically, on the use of pulsed DC fields to deliver molecules to normal and cancerous tissues in both animal models and in the clinic. The purpose of this work is to improve preventative vaccination, therapeutic vaccination, treatment of metabolic diseases, and cancer treatments. In parallel to this work, electrodes and electropulsing equipment had to be developed in order to apply this delivery method to specific tissues and for specific diseases. This has resulted in over 50 publications and about 25 issued US patents.