TBIS

Topic of the Speech:
Self-Powered Wearable and Implantable Electrical Stimulation Devices for Medical Treatments

Professor Xudong Wang
University of Wisconsin-Madison
USA

Professor Xudong Wang is the Grainger Institute for Engineering Professor in the department of Materials Science and Engineering at University of Wisconsin – Madison. He is a fellow of the American Institute for Medical and Biological Engineering. Dr. Wang received his PhD degree in Materials Science and Engineering from Georgia Tech in 2005.

His current research interests include studying the growth mechanisms of oxide nanostructures; developing advanced nanomaterials and nanodevices for mechanical energy harvesting from human activities and ambient environment; and understanding the coupling effect between piezoelectric polarization and semiconductor functionalities.

He has won number of prestigious national and international awards, including NSF CAREER Award, DARPA Young Faculty Award, Ross Coffin Purdy Award from the American Ceramic Society, and TR35 Award from MIT Technology Review. He has published more than 130 papers on peer-reviewed journals and his current h-index is 57.

ABSTRACT SUBMISSION

-For invited speaker only

Self-Powered Wearable and Implantable Electrical Stimulation Devices for Medical Treatments

Xudong Wang

Department of Materials Science and Engineering, University of Wisconsin-Madison Madison, WI 53706, USA

*Presenter's email: xudong.wang@wisc.edu

ABSTRACT (NO MORE THAN 500 WORDS:)

Electrical stimulation (ES) is a widely used therapeutic treatment strategy. It showed significantly positive results in treating a variety of diseases, biological disorders, and neurological problems. Today, the emergence of wearable devices is rapidly reshaping the development of medical devices, pushing them from conventional bulky and rigid silicon electronics to flexible and primarily polymer-based systems. Among many types of functions, nanogenerators are developed as a unique device for converting biomechanical energy into electrical pulses. Besides using it directly as a power source, this pulsed electricity can be applied directly as a ES signal for therapeutic treatment. In our recent research, we successfully implemented such an electromechanical system for skin wound healing and vagus nerve stimulation for obesity control. An electrical stimulation bandage was developed by integrating a flexible nanogenerator and a pair of dressing electrodes on a flexible substrate. Rat studies demonstrated rapid closure of a full-thickness rectangular skin wound within 3 days as compared to 12 days of usual contraction-based healing processes in rodents. From in vitro studies, the accelerated skin wound healing was attributed to the electric field-facilitated fibroblast migration, proliferation and transdifferentiation. In another work, an implanted vagus nerve stimulation system was developed. The device comprises a flexible and biocompatible nanogenerator that is attached on the surface of stomach. It generates biphasic electric pulses in responsive to the peristalsis of stomach. The electric signals generated by this device stimulates the vagal afferent fibers to reduce food intake and achieve weight control. This strategy is successfully demonstrated on rat models. Within 100 days, the average body weight is controlled at 350 g, 38% less than the control groups. Both results bring a new concept in designing wearable or implantable electrical therapeutic devices that are battery-free, self-activated and directly responsive to body activities.