FRONTIER FACULTY CANDIDATE

A Soft Approach to Electronics:
From Nanowire Arrays to Stretchable Systems

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125 Reber Building

Abstract:
Wearable devices that match the soft, curvilinear, and time-dynamic nature of the human body is an important trend for bio-integration, redefining not only the appearance, but also the design and fabrication of microelectronics. The search for pliable materials with superb electronic properties calls for strategies to bridge the gap between hard and soft – among which advanced engineering of the geometry and architecture of materials presents unique opportunities. A prominent example of geometry engineering is that nanowires of hard and brittle piezoelectric oxides such as ZnO and PZT can be used as a flexible energy source; their synthesis, properties and integration into an energy harvesting device will be discussed. For architecture engineering, the compressive straining of an elastic substrate can be used to fabricate previously inaccessible classes of 3D structures in monocrystalline materials. Conversely, rationally designed 2D geometries can buckle to form 3D layouts to accommodate tensile strain, resulting in unprecedented stretchability. This enables a series of device possibilities in stretchable electronics with mechanical properties similar to that of human skin. Combined strategies in materials processing, mechanical design and device and circuit construction for architecturally engineered stretchable electronics will be discussed. Demonstrations include a wirelessly rechargeable lithium ion battery with a record reversible biaxial stretchability up to 300%, and a skin-mounted soft health monitoring system with multifunctional physiological signal sensing and wireless power and data transmission.

Bio:
Dr. Sheng Xu is currently a postdoctoral research associate at the University of Illinois Urbana-Champaign, where he is working with Dr. John Rogers on stretchable electronics, including ultra-stretchable micro/nanostructures, energy storage devices, and mobile healthcare systems. He received his Ph. D. in Materials Science and Engineering from Georgia Institute of Technology in 2010, where his research focused on rational oxide nanowire synthesis, nanowire array based light emitting diodes and mechanical energy harvesters with Dr. Zhong Lin (Z.L.) Wang. His research interests primarily focus on advancing the interdisciplinary science and technology of soft electronics, energy materials, and nanotechnology.