Charles M. Lieber

Harvard University
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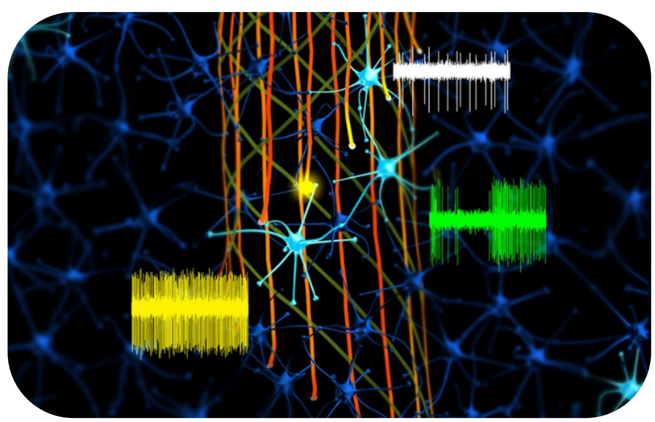
Charles M. Lieber received his undergraduate degree from Franklin and Marshall College and carried out his doctoral studies at Stanford University, followed by postdoctoral research at the California Institute of Technology. He was an Assistant Professor at Columbia University, and now holds appointments in the Department of Chemistry and Chemical Biology, as the Mark Hyman Professor of Chemistry, and in the John A. Paulson School of Engineering and Applied Sciences at Harvard University. He also serves as the Chair of the Department of Chemistry and Chemical Biology. Lieber has pioneered the synthesis of a broad range of nanowire materials, the characterization of the fundamental properties of these materials, the development of methods of hierarchical assembly of nanowires, and applications of these materials in nanoelectronics, nanophotonics, and nanocomputing. He has pioneered the field of nano- bioelectronics with seminal contributions to sensing, the development of novel nanoelectronic cell probes, and cyborg tissues.

Lieber's work has been recognized with many awards, including the MRS Von Hippel Award (2016), Remsen Award (2016), IEEE Nanotechnology Pioneer Award (2013), Willard Gibbs Medal (2013), and Wolf Prize in Chemistry (2012). Lieber is an elected member of the National Academy of Sciences and the American Academy of Arts and Sciences. He is Co-Editor of *Nano Letters*, and has published over 380 papers and is the principal inventor on more than 40 patents.

Abstract: Nanoelectronic Tools for Brain Science

Nanoscale materials enable unique opportunities at the interface between the physical and life sciences, for example, by integrating nanoelectronic devices with cells and/or tissue to make possible communication at the length scales relevant to biological function. In this presentation, I will overview a new paradigm for seamlessly merging nanoelectronic arrays and circuits with the brain in three-dimensions (3D), syringe-injectable mesh electronics. First, the design and properties of the mesh electronics with micrometer feature sizes and effective bending stiffness values similar to neurons and neural tissue will be described. Second, I will describe quantitative time-dependent histology studies demonstrating the absence of a tissue immune response on at least a year time-scale, as well as interpenetration of neurons and neurofilaments through the open mesh electronics structures. Third, I will report electrophysiology data demonstrating the capability to track and stably record from the same single neurons and neural circuits for more than a year. Fourth, I will describe several 'applications' of the unique mesh electronics capabilities that provide new insight into fundamental brain science problems, including aging and vision. Finally, the prospects for future advances of these nanoelectronic tools for overcoming complex challenges in neuroscience through the development of precision electronic therapeutics and brain-machine interfaces will be discussed.



Syringe-Injectable Mesh Electronics