Bionic Nano-Printing

Michael C. McAlpine, Princeton University (USA)

Abstract

The development of a method for interweaving high performance devices with biology could yield breakthroughs in regenerative medicine, smart prosthetics, and human-machine interfaces. Yet, most high quality inorganic materials are two dimensional, hard and brittle, and their crystallization generally requires high temperatures for maximally efficient performance. These properties render the corresponding devices incompatible with biology, which is three-dimensional, soft, flexible, stretchable, and temperature-sensitive. Nanotechnology provides a route for overcoming these dichotomies, by altering the mechanics of materials and devices in order to promote biological compatibility. Further, 3D printing offers the ability to seamlessly merge nanomaterials and devices with biology in three dimensions. Our group has developed methods for 3D printing electronic materials - including insulators, metals, and semiconductors - along with biological materials, to enable a future vision of 'bionic nanodevices,' in which the electronics and biology are seamlessly interwoven in 3D. The unique properties of nanomaterials, co-printed with "living" platforms, may enable exciting avenues in fundamental studies and bioMEMS applications, including creating augmented bionic nano-organs.