3D Printed Bionic Nanomaterials

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Abstract

The ability to three-dimensionally interweave biology with nanomaterials could enable the creation of bionic devices possessing unique geometries, properties, and functionalities. The development of methods for interfacing high performance devices with biology could yield breakthroughs in regenerative medicine, smart prosthetics, and human-machine interfaces. Yet, most high quality inorganic materials: 1) are two dimensional, 2) are hard and brittle, and 3) require high crystallization temperatures for maximally efficient performance. These properties render the corresponding devices incompatible with biology, which is: 1) three-dimensional, 2) soft, flexible, and stretchable, and 3) temperature sensitive. These dichotomies are solved by: 1) using 3D scanning and printing for hierarchical, interwoven, multiscale material and device architectures, 2) using nanotechnology as an enabling route for overcoming mechanical discrepancies while revealing new effects due to size scaling, and 3) separating the materials synthesis and 3D printed assembly steps to enable conformal integration of high quality materials with biology. The coupling of 3D printing, novel nanomaterial properties, and 'living' platforms may enable next-generation nano-bio interfaces and 3D printed bionic nanodevices.

Author Biography

Michael McAlpine is the Benjamin Mayhugh Associate Professor in Mechanical Engineering at the University of Minnesota. His research is focused on 3D printed bionic nanomaterials and has been featured in major media outlets, including Time Magazine and the New York Times. He has received a number of awards, most prominently an NIH Director's New Innovator Award, a TR35 Young Innovator Award, an Air Force Young Investigator Award, an Intelligence Community Young Investigator Award, a DuPont Young Investigator Award, a DARPA Young Faculty Award, an American Asthma Foundation Early Excellence Award, a Graduate Student Mentoring Award, and an invite to the NAE Frontiers in Engineering.