

NEURAL ENGINEERING SEMINAR SERIES

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When *Nano* Meets *Neuro*: Engineering High-Resolution Bioelectronics from Nanoscale Soft Conductors

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W306 Millennium Science



Flavia Vitale, Ph. D

Departments of
Neurology,
Bioengineering, Physical
Medicine and
Rehabilitation
University of
Pennsylvania

ABSTRACT: Bioelectronic technologies are powerful tools to treat neurological disorders, restore and repair lost functions, and modulate neural circuitry to control mood and behavior. The vast majority of bioelectronic interfaces, however, still rely on traditional noble metal and silicon materials, which are expensive to source and process, and are intrinsically inadequate to safely interface with soft tissues. In this talk, I will discuss how nanoscale nanomaterials can be engineered into high-resolution, minimally invasive bioelectronic interfaces designed to seamlessly map and control the activity of neural circuits at multiple scales. Specifically, I will describe the fundamental electrochemical properties of 2D transition metal carbides (a.k.a. MXenes) for recording and stimulation characterized via experimental and modeling analysis, and how these translate into significant impedance and noise reduction when MXenes are integrated into cellular-scale devices. Then, I will present *ad hoc*, scalable, rapid manufacturing processes designed to translate the exceptional material properties at the molecular scale into high-resolution, low impedance bioelectronic interfaces that are also compatible with clinical neuroimaging modalities, such a magnetic resonance imaging (MRI) and computerized tomography (CT). Finally, to illustrate the potential of MXene-based bioelectronics, I will present different examples of applications in both implantable and wearable devices.

BIOGRAPHY: Dr. Flavia Vitale is an Assistant Professor in the Center for Neuroengineering and Therapeutics at the University of Pennsylvania, and in the Departments of Neurology, Bioengineering, and Physical Medicine & Rehabilitation. She is also a core faculty member of the Brain Science, Translation, Innovation, and Modulation Center at Penn and of the Center of Neurotrauma, Neurodegeneration & Restoration at the Philadelphia VA. Dr. Vitale earned her B.S. and M.S. in Biomedical Engineering at the Università Campus Biomedico di Roma in 2008, and in 2012 she received her Ph.D. in Chemical Engineering at the Università di Roma “La Sapienza”. She completed a first postdoctoral training in Chemical Engineering at Rice University, followed by a postdoc in Neuroengineering at Penn, and in 2018 she joined the Penn faculty. Dr. Vitale’s work has been recognized with several awards, including the Taking Flight Award from Citizens United for Research in Epilepsy, the McCabe Fellow and Linda Pechenik Investigator Awards from the University of Pennsylvania, K12 Interdisciplinary Rehabilitation Engineering Career Development Award from the NIH, and the 2021 Global Young Scientist Award from iCANX.



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