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Stuttgart, Germany

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Armstrong Hall of Engineering, Room B071

Bioinspired Materials for Small-Scale Soft Robotics



Abdon Pena-Francesch is a Humboldt Postdoctoral Fellow at the Max Planck Institute for Intelligent Systems (Stuttgart, Germany) since 2018. He obtained his PhD in Engineering Science and Mechanics from The Pennsylvania State University (2017), and studied Mechanical Engineering (BSc, 2011) as well as Chemical Engineering (MSc, 2013) in the Chemical Institute of Sarrià (Barcelona, Spain). Abdon's research interests are in the field of biomaterials science, biomimetics, soft matter chemistry/physics, and nanotechnology. He is especially interested in exploring biological and bioinspired materials to develop advanced soft materials for robotic applications in healthcare and bioengineering. His work has received multiple awards from diverse organizations, including a Humboldt Research Fellowship (2018), Penn State Dissertation Award (2017), and the Materials Research Society Graduate Student Award (2016). For more details, please visit www.apenafrancesch.com.

Abstract: Small-scale soft robots offer the opportunity to adapt to dynamic environments and to access hard-to-reach areas inside the body for non-invasive operations. However, challenges in robot miniaturization, actuation, and safety (biocompatibility and biodegradation) remain to be addressed to take new medical robot concepts to the clinic. As the sizes of robots and devices are reduced to sub-centimeter scales, traditional power, actuation, and logic on-board elements need to be substituted by robotic functionalities encoded in the material properties. Thus, innovative development of soft materials with dynamic properties and their manufacturing across length scales are essential to produce sustainable and transformative robotic solutions in healthcare, bioengineering, and environmental technologies.

To overcome these challenges, we are developing biological and bioinspired protein-based materials with dynamic properties and robotic functionalities (sensing, adaptation to environment, self-healing, self-powering, on-demand degradation, etc.) programmed in the material itself through engineering of their molecular, nano-, and microstructure. This talk will present recent work on cephalopod-inspired proteins with programmable properties, biodegradable and multifunctional protein motors, self-healing soft actuators, and biomimetic stealth microrobots.