UNIVERSITÀ DI PAVIA

SEMINAR

December 18th, 2023 – h 14.00

Aula Seminari Magenta (ex Dip. di Elettronica – D floor)
Department of Electrical, Computer and Biomedical Engineering

De novo engineered living materials from bacteria

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Abstract:

Engineered living materials (ELMs) are composites of living cells incorporated into a biopolymer matrix. They are inspired by natural living materials but use synthetic biology to introduce non-natural properties. While cells confer functionality to ELMs, the matrix defines its mechanical and physical behavior. For this reason, engineering the collective self-organization of cells through a genetically encoded synthetic matrix has been a longstanding challenge in the ELM field. Prior to my work, most macroscopic ELMs either required significant processing to be assembled or were based on natural biomaterials and hence minimally tunable. Here, I present the first macroscopic de novo ELM, which grows from genetically-engineered bacteria. To achieve this goal, I engineered *Caulobacter crescentus* to display self-interacting proteins. In this way, I created a synthetic extracellular matrix that mediates the hierarchical organization of cells over four orders of magnitude, resulting in the growth of centimeter-scale living materials. Remarkably, the mechanical properties of de novo ELMs can be controlled through genetic modifications of the matrix protein. Moreover, it retained the natural ability of single *C. crescentus* cells to bind cadmium from contaminated solutions, demonstrating the potential to be a much more useful tool for heavy metal removal than a suspension of single cells by virtue of being a macroscopic, solid material. De novo ELMs can be reshaped and used as cementing agents, forming hard hybrid materials; they can also be desiccated at room temperature and reseeded into fresh medium to form new material, facilitating their transport and storage.

This study lays the foundation for growing ELMs with defined physical and mechanical properties, thus paving the way toward growing multifunctional, self-regenerating materials.

Bio:

Dr. Sara Molinari graduated from the Systems, Synthetic and Physical Biology Ph.D. program at Rice University with a thesis on programming differentiation in bacteria. This work enabled the creation of a novel pattern formation by physically separating genetically distinct cells. As a postdoctoral researcher, Dr. Molinari created the first de novo macroscopic living material that grows from engineered bacteria. This work presents the only genetically encoded synthetic matrix that hierarchically assembles cells over four orders of magnitude and allows the genetic control of ELM mechanical and catalytic properties. Leveraging her expertise in cell and matrix engineering, as a Professor, she develops engineered living materials with tailored biological and mechanical with a particular focus on biomedical applications. Sara is a full member of the Sigma Xi Scientific Research Honor Society, a University of Washington Distinguished Young Scholar (UWDYSS – 2022), a BME UNITE Future Faculty, and a rising star of the SynBYSS seminar series.

Organizer:
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Notes:
Seminar in English