



LMS Seminar

16 March 2023 at 2:00 pm - Room Jean Mandel

Ultra-soft magneto-responsive materials to open new avenues in mechanobiology

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ABSTRACT

Current research in biomechanics and mechanobiology faces critical limitations to control the mechanical environment (i.e., deformation, stiffness) of biological systems. A significant limitation exists in the real-time control and remote actuation of the mechanical environment. We present a novel experimental framework to modulate the mechanical properties of cell substrates using magnetorheological elastomers (MREs). We demonstrated reversible mechanical changes in substrates of more than one order of magnitude in stiffness and large local deformations (>30%). In parallel, we developed a multiscale computational model to guide the experimental testing. The whole experimental-computational framework is coupled to a customised imaging system for live cellular assays that allows for magneto-mechanical stimulation in real time. In addition, we coupled the system to nanoindentation instruments to enable the measurement of local changes in cellular mechanical properties during substrate deformation. Finally, the complete system is used to study the response of astrocytes to mechanical deformation by means of dynamic changes in morphology, stiffness and functional responses. These results offer direct benefits for health purposes by paving the path to models to simulate dynamic mechanistic-mediated biological processes as well as testing and design of new therapeutics.

BIOGRAPHY

Dr. Garcia-Gonzalez is Associate Professor and ERC Starting Grantee at Universidad Carlos III de Madrid. He has created the MULTIBIOSTRUCTURES Lab that puts together computational and experimental facilities to address challenges in advanced multifunctional materials and mechanistically mediated biological processes. His main active research lines are: 1) conceptualization of novel multifunctional materials; 2) biomechanics and mechanobiology of active biological systems; 3) 4D-printing technologies.

Website: <https://www.multibiostructures.com/>

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- [1] M.A. Moreno-Mateos, . . . , D. Garcia-Gonzalez. Magneto-mechanical system to reproduce and quantify complex strain patterns in biological materials. *Applied Materials Today*, 27:101437, 2022.
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