PhD in Bioengineering Final Defense

POLITECNICO MILANO 1863

PhD IZZO LUCA

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Aula Seminari – Alario

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PhD student:	**IZZO LUCA – XXXIII Cycle**
Thesis title:	***DESIGN AND VALIDATION OF NEW ORGAN-ON-A-CHIP DEVICES TO MODEL THE MICROBIOTA-GUT-BRAIN AXIS***
Advisor:	**Prof. CARMEN GIORDANO**

Abstract:

In the last decades, an intriguing concept referred as microbiota-gut-brain axis suggests a connection between our intestinal microflora, named microbiota, and neurodegenerative disorders. In 2017, an ERC project named MINERVA has been funded with the aim of developing the first engineered microbiota-gut-brain platform to investigate the hypothesis of such connection.
The platform will be based on several organ-on-a-chip millifluidic devices that model the individual biological systems involved in the above mentioned axis, connected between each other. As a first step towards the goal of engineering the entire platform, I have optimized and validated, from both an hydraulic and magnetic point of view, a Miniaturized Optically Accessible Bioreactor (MOAB) that represents the basic functional unit of the organ-on-chip platform MINERVA.
This first study allowed to design the first organ-on-a-chip prototype of the MINERVA platform, called MINERVA 1.0, which has been designed and developed in two alternatives to host cell suspensions, 2D cell layers and 3D cell cultures onto a semi-permeable membrane in the middle of the culture chamber. The designing of the MINERVA 1.0 has passed through computational modeling phases and experimental hydraulic tests to guarantee their hydraulic sealing and to choose the best membrane material and closure system. The MINERVA 1.0 device has been shown to be able to adequately support cell cultures as required for the brain model which is based on a 3D hydrogel embedded cell model. To furtherly improve the performance and versatility of the MINERVA 1.0 device, I designed a second generation of the MINERVA prototype, called MINERVA 2.0, characterized by greater flexibility. The main novelty carried by this new technological step is the possibility to integrate basically any commerically available Transwell®inserts. This new generation of organ-on-chips was conceived and both technically and biologically validated with suitable carried out results.

COMMITTEE MEMBERS		
Prof. Pasquale Striano	Prof. Luigi Ambrosio	Prof. Gabriele Candiani
Neurologia Pediatrica e Malattie Muscolari, Dipartimento di Neuroscienze, Riabilitazione, Oftalmologia, Genetica e Scienze Materno-Infantili, Istituto 'G. Gaslini',Genova	Istituto per i Polimeri, Compositi e Biomateriali, Consiglio Nazionale delle Ricerche, Napoli	Politecnico di Milano Dipartimento CMIC