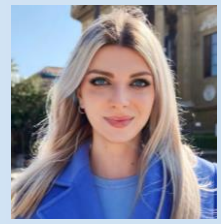
# DEVELOPMENT OF 2D AND 3D BIOPOLYMERIC COMPOSITES DEVICES FOR REMOVAL OF POLLUTANTS FROM AIR, WATER AND SOIL



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Sustainable Functional Bio-composites

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## Concept

Air, water, and soil contamination are currently major global problems. High levels of pollutant in air and water, as well as the excessive use of pesticides containing heavy metals can cause environmental damage and negative consequences for human health.

Biopolymeric porous structures, such as nanofibrous membranes and 3D-printed devices, have recently attracted increasing attention for pollutant removal applications. These structures can achieve improved capture efficiency thanks to their high porosity with interconnected pore structure and high functional surface area.

Additionally, agricultural and animal scraps, if not properly managed, can lead to adverse environmental impacts, including soil contamination and greenhouse gas emissions. Incorporating these natural scraps into biopolymeric matrices may reduce plastic usage, thus decreasing costs and promoting more eco-friendly processes.

A possible solution to the aforementioned problems consists of producing 2D and 3D polymeric composite devices based on biodegradable matrices and natural fillers obtained from agricultural and/or animal scraps with pollutant removal ability.

The production of such devices for air, water, and soil remediation will be the focus of my PhD project.

## Scientific approach

The PhD Project consists in the development of functional devices based on biodegradable polymers and natural fillers to capture pollutants from air, water, and soil. Initially, a comprehensive selection process will be undertaken to identify suitable materials and production techniques. This selection phase will prioritize:

i) the identification of sustainable, cost-effective, and biodegradable polymeric matrices;
ii) use of fillers derived from vegetable or animal scraps to enhance eco-friendliness;
iii) exploration of innovative manufacturing techniques, considering both melt and solution-based methods, with the aim of producing porous 2D or 3D devices.

After parameter optimization, the materials will undergo thorough full characterization. Once all properties align with the required standards, laboratory-scale functional tests will be conducted for air filtration, FOG (Fat, Oil, and Grease) absorption, and soil contaminant removal.

## Research objectives

- Development of bio-composites fibrous membranes based on biopolymeric matrices and agricultural or animal waste for air filtration applications
- Development of bio-composites fibrous fluff based on biopolymeric matrices and agricultural waste for FOG (fat, oil, greases) absorption from wastewater
- Development of 3D-printed devices based on biopolymeric matrices and agricultural or animal waste for Cu(II) capture from soil