UNIVERSITÀ POLITECNICA DELLE MARCHE

Development and characterization of Sustainable Biopolymer-Based Food Biosensors using Polylactic Acid (PLA)

Prof. Simona Sabbatini

Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU)- www.simau.univpm.it/

Supervisor: Prof. Simona Sabbatini
Research Group Description

Prof. Simona Sabbatini (Associate Professor of Chemistry)

https://orcid.org/0000-0002-2383-787x (publications in peer-review journals: 63 + 2 chapters of book, total number of citations 1450, H index 23)

Research interests: she coordinates research activities in the following research fields:
vibrational analysis and characterization of biological material, biomaterials, synthetic nano-structures, microplastics, bitumens and inert materials. Synthesis and spectroscopic characterization (FTIR, both in the medium and in the near infrared, NMR and EPR) of biodegradable polymers and their degree of crosslinking.

Teaching activity: course of "Chemistry" (CHIM/07) and course of "Diagnostics for restoration" Polytechnic University of Marche, Ancona, Italy;

Projects: PNRR Vitality-Innovation, digitalisation and sustainability for the diffused economy in Central Italy - (D.D. n. 3277/2021, CUP I33C22001330007), PNRR MOST-Sustainable Mobility Center (Centro Nazionale per la Mobilità Sostenibile – CNMS)" (D.D. n. 3138/2021, CUPCN00000023), AMOCEAB -Adrion Master On Circular Economy And Bioeconomy (CUP I53C23000110005), *PLaCE – ARS01_00891*.

Academic duties: Member of Quality Committee of the Degree Course in Mechanical Engineering, Member of the Commission for tutoring and guidance and member of the Review Commission for the Faculty of Engineering of the Marche Polytechnic University, Member of the Commission of PhD teachers in "Civil, Environmental, Building and Architecture Engineering"

Most recent publications:https://doi.org/10.1002/smsc.202300286,
https://doi.org/10.1016/j.scitotenv.2024.169898,https://doi.org/10.1021/acsomega.3c07637,
https://doi.org/10.1021/acssusresmgt.3c00002, https://doi.org/10.1016/j.colsurfa.2023.131388 .

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Research Group Description

Group description and expertise

E. Laudadio https://www.univpm.it/emiliano.laudadio
P. Stipa https://www.univpm.it/pierluigi.stipa
S. Sabbatini https://www.univpm.it/simona.sabbatini
F. Luzi https://www.univpm.it/francesca.luzi

} *SIMAU*

S.Rinaldi https://www.univpm.it/samuele.rinaldi } *DISVA*

- Characterization of organic, inorganic and biological materials by means of (micro) FTIR spectroscopy, NMR spectroscopy and HPLC Mass spectrometry.
- Analysis and characterization of biodegradable polymers (viscosity, mechanical and thermal properties)
- Evaluation of oxidative processes in polymeric as well as in biological systems. Study of chemical reaction mechanisms involving organic free radicals in different systems (autooxidation processes)
- Modeling and simulations of complex macromolecular systems and related chemical-physical properties.

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Research Group Description

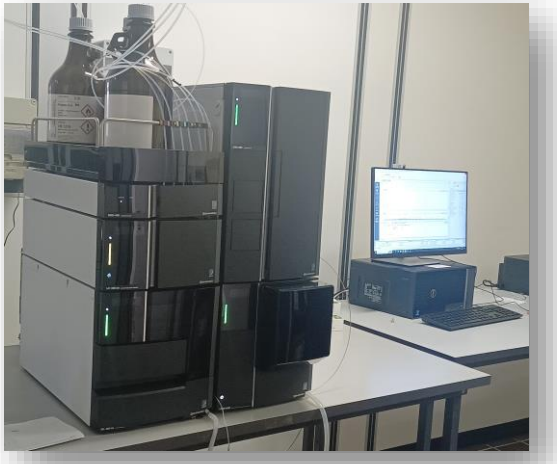
Perkin Elmer FT-IR spectrometer

Modeling and Simulation Laboratory

Bruker EPR spectrometer

Chemistry Laboratory

*Bruker NMR spectrometer***



*Shimadzu LCMS-2025 Mass spectrometer***

*Antor Paar Rheometer**

*financial support from Vitality project
** financial support from MOST project

UNIVERSITÀ POLITECNICA DELLE MARCHE

Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU)

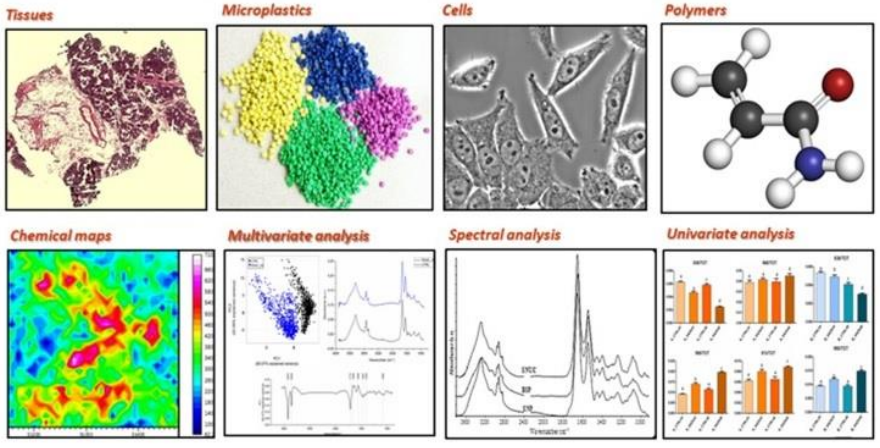
Director: Prof. Pierluigi Stipa

(http://simau.univpm.it/)

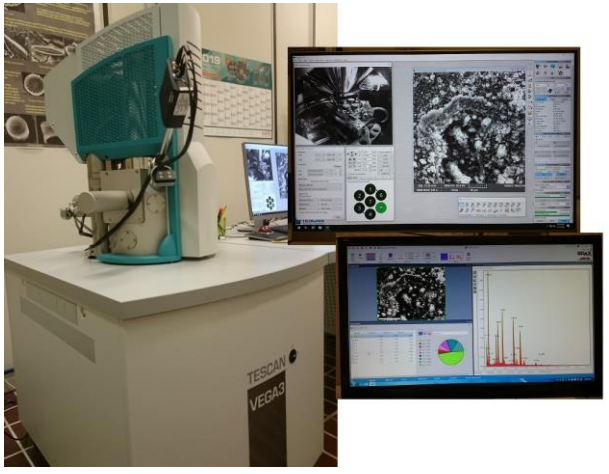
Structure in which the **confluence of different expertises** yield high-level teaching and high-profile international research in the field of **Science of Matter** and **Earth Sciences** with a special focus toward the **Environment**.

It operates within the **Engineering Faculty** offering teachers specialised in the so-called «hard sciences» (**Chemistry** and **Physics**) as well as theachers involved in more «applicative» fields, such as **Materials Engineering**, **Geotechnics**, **Geology**, **Environmental Engineering** and **Urban Planning**.

- **TECHNICAL ARCHITECTURE**
- **APPLIED GEOLOGY AND HYDROGEOLOGY**
- **ENVIRONMENTAL CHEMICAL ENGINEERING**
- **GEOTECHNICAL ENGINEERING**



Research Area



- **CHEMISTRY (ORGANIC)**
- **MATERIALS SCIENCE AND TECHNOLOGY**
- **EXPERIMENTAL PHYSICS**

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Project Idea: Development and characterization of Sustainable Biopolymer-Based Food Biosensors using Polylactic Acid (PLA)

Integrating biosensors into food packaging materials can enable us to assess the quality of food products. Intelligent packaging monitors food products using active compounds that change based on the physicochemical and microbiological properties of foods.

The materials selected for creating biosensor packaging must fulfill the requirements for the biomolecule deposition but also meet the standard packing properties such as gas barrier properties and vapor or moisture permeability. Typical substrates utilized for intelligent biosensor packaging include natural polymers, primarily derived from agricultural crop-based feedstocks.
Among them, PLA exhibits good functional properties and satisfies various packaging requirements to improve shelf life and food protection. PLA could be further enhanced with antimicrobial activity through the incorporation of natural essential oils, displaying a promising active packaging to maintain high standards in terms of environmental sustainability.

The target of the project is to produce eco-friendly and biodegradable polymers using PLA as a base for the development of food biosensors. The project aims to investigate their biocompatibility and environmental sustainability, improve their barrier properties, and optimize their specificity through controlled modifications of the chemical structure of PLA.