

Development of Microwave Applications in Biomass Conversion – from Lab to Pilot Scale

Dr. Mariana Patrascu

Faculty of Power Engineering, National University of Science and Technology Polytechnic of Bucharest, Splaiul Independentei no. 313, District 6, Bucharest RO-060042, Romania
Contact E-mail: marianapat29@hotmail.com

Europe's transition towards climate neutrality and circularity is underway.

In the current context, our group CHEMPOWER, from the Faculty of Power Engineering of the National University of Science and Technology Polytechnic of Bucharest, is permanently preoccupied to find new research opportunities through the conversion of biomass into energy and valuable compounds. Our main interest is the application of conventional and emerging technologies for the valorisation of biomass such as plastics, wood, organic residues, food waste. Our laboratory is equipped for the following activities: thermo-physical-chemical characterisation of solid and liquid fuels; determination of flue gas composition; thermogravimetric analysis of solid fuels; preparation of bio-oils for obtaining biofuels; combustion/pyrolysis/(steam)-gasification experiments in reactors with continuous operation and in batches; CO₂ capture processes with different types of solvents and under different process conditions; modelling and simulation of CO₂ capture processes.

A selection of available pilot and lab-scale installations: i) pilot installation for pyrolysis, gasification and combustion processes. - electrically heated rotary kiln 30 kg/h, temperature up to 1100°C; ii) CFBC for co-combustion, gasification (circulating fluidized bed) - 10 kg/h, temperature up to 900°C; iii) pyrolysis reactor – 10 kg/h, temperature up to 700°C; iv) microwave generators 5kW, 915 MHz magnetron based, 600 W, 915 MHz solid state, and 3 kW, 2.45 GHz; magnetron based; v) tubular batch reactor for pyrolysis, gasification and

combustion processes; vi) calcinations oven Nabertherm.

A selection of the analytic equipment: micro GC; calorimeter; flue gas analyzer Testo 350xl; gas chromatograph – mass spectrometer; thermo-gravimetric differential analyzer TG-DTA; spectrophotometer with atomic absorption; FT-IR spectrophotometer; UV-VIS spectrophotometer.

In the last six years we have won two European projects: *Production of BIOfuels through innovative pyrolysis/gasification methods and advanced TECHNOLOGIES (Figure 1)* and *Green chemistry and thermochemical processing, a convergent approach towards biobased chemicals and hydrogen synthesis, ConverGreen*.



Logo of the BIO Nov PyroTECH project.

The main objective of the recent ConverGreen project is to create a research group of excellence at the National University of Science and Technology POLITEHNICA Bucharest in the field of bio-products and hydrogen production, based on fundamental research leading to innovative processing

techniques that will contribute to future scientific advances. Both projects are dedicated to microwave heating, studying the properties of the material and simulating the designs, devices and processes using COMSOL multiphysics software.

During the projects, the group leader, Prof. Dr. Eng. Cosmin Marculescu, has established partnerships with renowned universities, namely Biological and Agricultural Engineering, LSU* & LSU Agricultural Centre and AGH University of Science and Technology, Krakow, Poland.

These collaborations increased the international visibility of the Romanian team through the publication of 20 research papers and four patents.

About the author



Dr. Mariana Patrascu received her Ph.D. from the Faculty of Applied Chemistry and Materials Science, University POLITEHNICA of Bucharest, Romania in 2012. In 2021, she completed a post-doctoral study with the Faculty of Power Engineering, University POLITEHNICA of Bucharest. She is an associate of CHEMSPEED

Ltd., Bucharest – Research & Development Laboratory in the field of microwave and ultrasound technology and from 2022 an Associate Professor at the Faculty of Power Engineering, National University of Science and Technology Polytechnic of Bucharest. She is a Fellow of the Royal Society of Chemistry. Her research focuses on microwave and ultrasound assisted processes and technologies. Mariana is (co-)author of more than 32 national patents and 5 international patents, 35 scientific publications in peer-reviewed journals and collaborator/leader of 20 research projects. During more than 25 years of activity in the field of microwave and ultrasound chemistry, she has been awarded 10 gold medals at the International Exhibition of Inventions in Geneva, Switzerland and at the World Exhibition of Innovation, Research and New Technology "Eureka", Brussels and at the IX Edition of the International Exhibition of Inventions and Innovations "Traian Vuia", Timisoara in Romania.



Participants to the CoverGreen project.



Further participants to the CoverGreen project.

* Louisiana State University