



PhD opportunity at University College Dublin to develop Materials and Processes to Upcycle Plastic Waste

Institution: University College Dublin (UCD)

Supervisor: Prof. James Sullivan (UCD)

Project title: Pyrolysis of plastic waste – influence of conditions and heterogeneous catalysts on reactivity and product distributions

Stipend: 4 years funding at €25,000 per year + University fees.

Start date: from 01/09/2025

Project description

Broader context

Due to its resistance to decomposition / further reaction, plastic waste (and its conversion into microplastics) poses significant environmental and health problems.

This project, a collaboration between research groups in the [UCD School of Chemistry](#) and the [UCD School of Food and Biosystems Engineering](#) student will study the conversion of waste plastics (e.g. polythene) into fuels (e/g/ gasoline / diesel) and chemicals (e/g/ ethylene, propylene) through pyrolysis in the presence of heterogeneous catalysts (zeolites, mesoporous materials, sulphated oxides).

Pyrolysis involves heating the materials to relatively high temperatures in the absence of air – and results in the decomposition of the polymeric plastic into smaller molecules. It is hoped the heterogeneous catalysts will then direct the conversion of these into selected fuels or chemicals.

The chemistry group has experience in the preparation, characterisation and application of catalysts and the Food Engineering group has experience in the identification and characterisation of microplastics.

The reactions will initially be carried out in autoclave systems with product analysis using GC/MS, GC and HPLC. The plastics studied will include polyethylene, polypropylene, polycarbonate, and poly-methyl-methacrylate before moving to more challenging (in terms of catalyst stability) materials such as Cl and N-containing materials. We will also look at the effects of plastic pretreatments (e.g. ball milling) on the product distribution

The plastic substrates and the residues following reaction or partial reaction will be characterised using the suite of equipment available in Dr Junli (Lily) Xu's lab, including AFM-IR, Py-GC-MS, O-PTIR and Raman Spectroscopy. Advanced data analytics, including machine learning and deep-learning algorithms, will be applied to model and predict pyrolysis outcomes, optimizing the process for maximum efficiency and sustainability.

The PhD candidate's project will involve a significant amount of instrument led characterisation (in both labs) and the use of data analytics and machine learning (in the Biosystems engineering lab) and catalyst preparation and reactivity evaluation (chemistry lab).

Eligibility:

Applications are welcome from highly motivated individuals who are interested in solving real-world challenges related to the circular economy and green and sustainable chemistry. The candidate should have or be close to completing a bachelors or master's degree in Chemistry, Materials Science, Chemical Physics, Chemical Engineering or a related STEM discipline and should achieved, or expect to achieve degree classifications at either 1st class honours or second class honours grade 1. .

The candidate should have excellent written and oral English and communication skills. Programming and statistical skills are highly desirable. The desired candidate should have interest in Sustainable Chemistry.

The project will require dissemination of results both nationally and internationally, so the candidate will have opportunities to travel both nationally and internationally. The highly collaborative nature of the project would also require the candidate to have good interpersonal skills and a cooperative work ethic.

The successful candidate will work on several projects with clear goals, deliverables, and schedules, and will be based at University College Dublin at the School of Chemistry, but collaborate closely with colleagues in the School of Food and Biosystems Engineering.

Supplementary information:

The University:	https://www.ucd.ie/
UCD Strategy 2030: Breaking Boundaries	https://strategy.ucd.ie/
UCD College of Science:	https://www.ucd.ie/science/
UCD School of Chemistry:	https://www.ucd.ie/chem/
Equality Diversity and Inclusion at UCD	https://www.ucd.ie/workatucd/diversity/

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