

PHD POSITION: METHANE UPGRADING BY ULTRA-FAST PLASMA PYROLYSIS

We seek PhD candidates to work on methane upgrading using fast-pulsed microwave generated plasma. The research will primarily be experimental - the candidate will perform product gas analysis combined with state-of-the-art laser diagnostics to develop a comprehensive understanding of the underlying physical and chemical processes occurring in the plasma.

PROJECT DESCRIPTION

The chemical industry urgently needs to cut its CO₂ emissions. *Electrification* will reduce emissions from processes by powering them with renewable electricity in place of fossil fuels. *Circular processes* will reuse valuable resources (e.g. plastics), and in doing so will cut end-of-life emissions and reduce resource depletion rates. We research novel *plasma technologies* to facilitate both electrification and circular processes for the chemical industry. In future, industry expects to have an environmentally sustainable source of methane, which can be most effectively valorised via upgrading to ethylene; a crucial feedstock in the production of plastics. However, methane-to-ethylene conversion is notoriously difficult, as it is a strongly endothermic reaction with highly complex chemistry. Thermal plasma technology is a promising approach for methane to ethylene conversion as it allows the possibility for high efficiency, excellent reactant conversion, and refined product selectivity.

In this project, we use microwave generated plasma to induce ultra-fast heating and quenching of methane and its reaction products, at rates around $10^6 - 10^8$ °C/s. With such ultra-fast heating and quenching, we can induce thermal decomposition of methane and freeze the reaction products before further chemistry has time to occur. There is a short window of opportunity where highly selective conversion of methane to ethylene should be possible. In this project we will evaluate this *window of opportunity* – this requires temporally and spatially resolved in-situ measurements, a task which is ideally suited to laser diagnostics. We will assess the chemistry occurring within the plasma, from which we will determine – is it possible to selectively produce ethylene by ultra-fast thermal plasma processing of methane?

JOB DESCRIPTION

The successful candidate is expected to perform laboratory experiments to evaluate processes occurring in methane plasma discharges. Experiments will be performed in our new laboratory, located at Chemelot, 20 km North of Maastricht. You will work independently to collect, analyse, and evaluate experimental data. You will join a small team working on similar (i.e. plasma and spectroscopy) experiments. We expect that you will regularly discuss, share, and present your work with fellow team members, colleagues, and wider audiences at international conferences. We expect you will write a number of high-quality scientific articles, ultimately culminating in your PhD thesis.

REQUIREMENTS

- We seek strong applicants who have a Master's degree in chemistry, physics, chemical engineering, or other similar engineering or science disciplines
- Prior knowledge of plasma chemistry, laser diagnostics, hydrocarbon chemistry, or photonics is preferred but not essential
- Demonstrated affinity and ability with research work is preferred

- Experience with some form of analytical or scientific programming language is beneficial, e.g. Python, R, LabVIEW, Matlab, Mathematica, etc.
- You have fluency in both written and spoken English
- You are able to work both independently and as part of a team

CONDITIONS OF EMPLOYMENT

- We offer a rewarding career at a young university in the heart of Europe, with a distinct global perspective and a strong focus on innovative research and education;
- The terms of employment of Maastricht University are set out in the Collective Labour Agreement of Dutch Universities (CAO), supplement with local UM provisions. For more information on terms of employment, please visit our website www.maastrichtuniversity.nl > Support > UM employees;
- Your salary would be € 2.395,- gross per month in the first year up to € 3.061,- gross per month in the fourth year according to the PhD-candidate salary scale. (Based on a full-time appointment). On top of this, there is an 8% holiday allowance and a 8.3% year-end allowance;
- We offer an attractive package of fringe benefits such as reduction on collective health insurance, substantial leave arrangements, optional model for designing a personalised benefits package and application for attractive fiscal arrangements for employees from abroad.

CONTRACT TYPE

PhD

We offer a full-time employment contract as a PhD candidate. The employment contract will be for a period of 1 year and will be extended for another 3 years after positive evaluation.

EMPLOYER

ACADEMIC STAFF

Located in the heart of Europe, UM is the most international university in the Netherlands with half of our students and one third of academic staff coming from abroad. In total, UM has around 18.000 students and 4,300 employees and represents 100 different nationalities. Maastricht University is a stimulating environment where research and teaching are complementary, where innovation is our focus and where talent can flourish. Research is characterised by a multidisciplinary, thematic, and collaborative approach, and with education, forms the core of UM.

Not convinced/Eager to learn more? Take our virtual [campus tour](#) to get a sense of our university culture, the city of Maastricht, and your potential working environment.

Faculty of Science and Engineering

The Faculty of Science and Engineering (FSE) is home to several outstanding departments and institutions covering education and research in Science, Technology, Engineering and Mathematics (STEM) as well as the liberal arts and sciences.

DEPARTMENT

We are part of the newly created Circular Engineering Department in the Faculty of Science and Engineering at Maastricht University. Our research group is uniquely situated in the heart of the Dutch chemical industry at the Brightlands Chemelot campus, 20 km north of Maastricht. Our strong links with industry give excellent opportunity to build collaborations and partnerships, giving good prospects for a future career in industry. Our group has a strong expertise in plasma science, with each of our respective members having an established international reputation for high quality scientific output in the fields of plasma chemistry, plasma modelling, spectroscopy, and laser diagnostics. We have excellent international connections with esteemed laboratories, and we therefore expect the applicant will have the opportunity to work abroad during their PhD.

ADDITIONAL INFORMATION

More information on this vacancy can be obtained from Tom Butterworth:

t.butterworth@maastrichtuniversity.nl

Or Gerard van Rooij:

g.vanrooij@maastrichtuniversity.nl

DIVERSITY STATEMENT

Maastricht University is an international organization, embracing a diverse student and staff population. We strongly believe that diversity is our advantage and creating an inclusive working climate in which students and staff feel a valued member of the UM community is therefore a top strategic priority. UM values [diversity](#) within its community and encourages you to apply.