

Faculty of Science and Engineering

Profile report: Electrochemical conversion of renewables/ Elektrochemische omzetting van hernieuwbare grondstoffen

- Discipline: Electrochemistry, Electrocatalysis, Chemical Engineering, Mechanical Engineering
- Level: Tenure track assistant professor
- Fte: Full time (1.0)

1. Scientific discipline

The research focus of this position is on electrochemistry and electrocatalysis in an engineering environment for the conversion of renewable resources (e.g. H₂O, CO₂, biomass) to energy carriers, fuels and chemicals. Electrochemistry and the related engineering aspects will play a crucial role in enabling the production of industrially important chemicals (e.g. H₂ and C-based bulk chemicals and fuels) from such renewable resources in electrochemical cells. Though research in electrochemistry has a long-standing history, the transition towards a more sustainable, electrified chemical industry has revamped the interest for this discipline, and defined new challenges that range from understanding and enhancing the electrocatalytic systems at the molecular level to engineering the electrochemical cell/reactor at the large scale.

2. Vacancy

This position is opened by the Board of the Faculty of Science and Engineering (letter with reference JPT/gl/17/00662) and will be embedded in the institute Engineering and Technology Institute (ENTEG), basic unit Product Technology (PT). The position falls within the framework of 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see this link for [criteria and conditions](#).

3. Selection committee (BAC)

- Prof. Dr. Ir. H.J. Heeres, professor Green Chemical Engineering Technology, scientific director ENTEG (chair);
- Prof. Dr. F. Picchioni, professor Product Technology, education director ENTEG, programme director bachelor programme chemical engineering;
- Prof. Dr. B. Jayawardhana, professor Mechatronics and control of nonlinear systems, programme director master programme mechanical engineering, ENTEG;
- Prof. Dr. P.P. Pescarmona, associate professor Sustainable Chemical Products and Catalysis, programme director of the master programme chemical engineering, ENTEG;
- Prof. Dr. Moniek Tromp, professor Materials Chemistry
- Prof. Dr. Ir. Pauline Herder (TU Delft)
- student member

Advisors

- Mr. F. Salverda, HR advisor
- Dr. K.E. Voskamp, scientific coordinator ENTEG

4. Research area

The development of efficient electrochemical systems for the conversion of renewable resources (H₂O, CO₂, biomass) into useful chemical products (H₂ and C-based bulk chemicals and fuels) employing electricity obtained from sustainable sources like wind and solar power is a strategically crucial area of research for enabling the transition to a more sustainable chemical industry and society. In the same context, the processes in which electricity is generated either in a fuel cell or with cogeneration of useful chemical products are also of strategic importance.

Some of these technologies are close to large-scale applications (hydrogen production through water electrolysis), whereas for others current research is still at a lower technology readiness level. The candidate is expected to address research questions at these different technology readiness levels and thus to be able to carry out research in electrochemistry and electrocatalysis that encompasses molecular and engineering aspects, e.g. from the development of efficient electrocatalytic materials to the improved design of the electrochemical cells. For this position, the focus is on low-temperature (< 100 °C) electrochemical cells.

5. Embedding: institute (and basic unit)

The research institute ENTEG is *the* engineering and technology institute of the Faculty of Science and Engineering (FSE) of the University of Groningen. ENTEG research is highly multidisciplinary in nature and focuses on fundamental and engineering research on the development of new and innovative processes and products. ENTEG currently houses 10 research units with research conducted in three key research domains:

- (sustainable) products and processes,
- model-based design and control of processes and systems,
- complex materials.

ENTEg staff, in general, strongly links to various education and research programmes, namely: Chemical Engineering, Mechanical Engineering, and Industrial Engineering and Management degree programmes.

The candidate for this position is expected to set up her/his research line on electrochemical conversion of renewables within the Chemical Engineering - Product Technology (PT) unit of ENTEG. Research within PT is focused on the design of new or improved chemical products. PT has close research and teaching links with another Chemical Engineering unit in ENTEG: Green Chemical Reaction Engineering.

The current position will benefit from and strengthen the current research activities of ENTEG in the field of electrochemical conversion of renewable resources to energy carriers, fuels and chemicals. The focus of this position will be complementary to the current expertise available in ENTEG in (electro)catalysis (Prof. Pescarmona), in the conversion of renewable resources (Profs. Deuss, Heeres, Pescarmona) and in high-temperature electrochemical processes (Dr. Kyriakou).

Other research and teaching links are expected with the Mechanical Engineering oriented units of ENTEG – such as the research units Advanced Production Engineering, Computational Mechanical & Materials Engineering, and Discrete Technology & Production Automation. At the same, the position may open further collaborative avenues within the FSE such as with researchers of the Zernike Institute for Advanced Materials, the Stratingh Institute for Chemistry and the Energy and Sustainability Institute Groningen (ESRIG) where research on electrochemical systems is also carried out.

6. Local and (inter)national position

At a (inter)national level, the production of green hydrogen through water electrolysis and the electrification of the chemical industry have been identified as strategic research targets to increase the sustainability of industry by mitigating CO₂ emissions and to decrease the dependence from natural gas. In the Netherlands, this is demonstrated by the establishment of the ECCM (<https://www.co2neutraalin2050.nl/>), by the increased number of national projects involving large industrial-academic consortia (e.g. E2CB; www.e2cb.nl/; Release: <https://nwo-release.nl/>) and by initiatives for enabling the upscaling of hydrogen production such as the Hydrohub MegaWatt Test centre, which is currently under construction at the Zernike Campus in Groningen (<https://campus.groningen.nl/en/news/new-hydrohub-on-zernike-campus>; <https://ispt.eu/projects/hydrohub-megawatt-test-centre/>).

The PT group is currently addressing these challenges from the point of view of the design of the electrocatalysts, while taking into account applicability at the large scale. The group is active in several National (E2CB, Release, HydroHub) and EU (<https://www.recodeh2020.eu/>) projects that focus on electrochemical conversion of renewables into useful chemical products.

The current position will aim at strengthening the role of the PT group in this domain by providing expertise in electrochemistry for low-temperature processes. It will bridge molecular and engineering aspects and thus comprise both fundamental and applied elements. Hence, the research line will differ from that of other groups in the Netherlands, which focus either on fundamental aspects of electrochemistry (Prof. Koper, University of Leiden, but also the Stratingh Institute (FSE)) or on the engineering of the electrochemical processes (e.g. Profs. Herder, de Jong, Dam TU Delft, but also ESRIG (FSE)). Therefore, this position will benefit from and contribute to expand the existing network of collaboration with the industry and with other universities in the Netherlands (e.g. ISPT, Nouryon, Avebe, TNO, University of Leiden, Wageningen University & Research, TU Delft).

A unique feature of the University of Groningen is the possibility to place the engineering research in the broader context through collaboration with other groups within the university (e.g. from the Faculty of Economics and Business and the Faculty of Behavioural and Social Sciences), and in such a way to foster scientific progress that takes into account societal aspects.

On a local level, this position will contribute to the ambition of the North of the Netherlands and of the University of Groningen to be an important hub for green hydrogen production and more in general for electrochemistry, exploiting the advantageous location (wind energy offshore park in the Northern Sea, industrial harbours at Delfzijl and Eemshaven) and existing infrastructure (gas pipelines network).

7. Expected contributions to research

The candidate is expected to initiate and set up his/her research line in the field of electrochemical conversion of renewables. The research should compete on a worldwide level and lead to publications in top journals. Obtaining substantial external funding is crucial. Supervision of PhD students is an important part of the research activities. The research is expected to cross-fertilize the existing research within the institute and should lead to a strengthening of the international reputation of the group and the institute.

8. Expected contributions to teaching

The candidate will contribute 30% of his/her time to teach mainly at the master programme in Mechanical Engineering¹ and the bachelor and master programmes Chemical Engineering². He/she will play an active role in the development of these educational programmes. She/he is expected to participate in the teaching of specialized courses in relation to electrochemistry, renewable resources and other related topics. Furthermore, the candidate will be involved in supervising bachelor and master students.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. At the level of the FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees, in the fields of teaching, research and management. The candidate will participate in relevant national and international organizations.

¹ Details of the MSc Mechanical Engineering can be found at <https://www.rug.nl/ocasys/ucg/vak/showpos?opleiding=6700>

² Details of the BSc Chemical Engineering programme can be found at <https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=4965> and that of the MSc Chemical Engineering programme can be read in <https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=3235>