

Faculty of Science and Engineering

Profile report: *Tenure track assistant professor with education profile on Polymer-based composite materials (Polymeer gebaseerde composiet materialen)*

- Discipline: *Chemistry or Chemical Engineering*
- Level: Tenure-track assistant professor with education profile
- Fte: 0,8-1,0 fte

1. Scientific discipline

Polymer-based composite materials are increasingly replacing conventional inorganic materials, mainly due to their lower density, low production costs and easily tailorable performances, especially related to mechanical properties. This position will predominantly focus on producing polymer-based composite materials (such as bio-based, biomedical or high-tech composites) and the investigation of their properties both at the microscopic and macroscopic scale. The educational focus will be on the programs chemistry (CH), chemical engineering (CE) and industrial engineering and management (IEM) and this expertise is also highly valuable for the program mechanical engineering (ME).

2. Vacancy

This position is opened by the Board of the Faculty (ref. PT/gl/21/00267) and will be embedded in the Zernike Institute for Advanced Materials, basic unit Macromolecular Chemistry & New Polymeric Materials or optionally Polymer Science. The criteria and conditions pertaining to the position are described in the document 'Assistant professor with an education profile'.

3. Selection committee (BAC)

Prof.dr.ir. C.H. van der Wal, scientific director of the Zernike Institute for Advanced Materials and professor Physics of Quantum Devices (Chair)

Prof.dr.ir. B.J. Kooij, education director of the Zernike Institute for Advanced Materials and professor Nanostructured Materials and Interfaces

Prof. dr. K. Loos, professor for Macromolecular Chemistry & New Polymeric Materials

Prof.dr. M. Kamperman, professor for Polymer Science

Prof.dr. F. Picchioni, program director bachelor Chemical Engineering, professor for Product Technology

Vacancy (external member)

Student member

Dr. J.P. Birkner (advisor, Research Manager Zernike Institute)

Ms. A. van der Woude (advisor, Human Resources)

4. Area of expertise

The position is created in order to build expertise on polymer-based composite materials in Groningen. Polymer-based composite materials are increasingly replacing conventional materials, mainly due to their lower density, low production costs and desirable performance characteristics, especially related to mechanical properties. Currently a specific focus on such composites is hardly present in both education and research within FSE, which can be regarded as an omission based on the current importance and great future prospects of this material class. The expertise of the position is expected to fill this gap while aligning well with the ongoing research and teaching efforts of groups related to macromolecular chemistry, polymer science and product technology and to make synergistic use of the knowledge and facilities available. The position offers great opportunities to strengthen the teaching of courses in the chemistry (CH), chemical engineering (CE), mechanical engineering (ME), biomedical engineering (BME) and industrial engineering and management (IEM) programs. The educational programs BME (bachelor) and ME (master) are relatively new, and may couple very well to the proposed focus on composites. The development of multifunctional composites, e.g. which in addition can actuate or sense, offers even more innovative prospects for BME and ME. By linking the own expertise to that already present at FSE the position may play a very central role in the education of the future.

5. Embedding: institute (and base unit)

The position will preferably be embedded within the research unit Macromolecular Chemistry & New Polymeric Materials, but based on the profile of the candidate may find embedding in the group Polymer Science as well. Both groups are part of the Zernike Institute for Advanced Materials.

The mission of the Zernike Institute for Advanced Materials lies in focused, curiosity-driven, symbiotic studies of functional materials involving researchers from physics, chemistry and bio-nanosciences. The Zernike Institute's main driving force is the desire to understand how things work at the microscopic level, i.e. the atomic and molecular scale. This is the realm of nanoscience and nanotechnology. In this field, the Zernike Institute for Advanced Materials covers the whole chain from synthesizing materials, building devices, characterizing materials and devices, and investigating the theoretical foundation of their properties. The institute performs interdisciplinary research with other Institutes of the Faculty of Science and Engineering and with the University Medical Center Groningen (UMCG) within the framework of the faculty theme "Advanced Materials".

The research unit Macromolecular Chemistry & New Polymeric Materials is led by Prof. Loos. The group has a research program focused on the design, synthesis and characterization of novel tailor-made macromolecules as well as on the development of sustainable, eco-efficient and competitive production methods of polymeric materials. By utilizing modern polymer synthesis techniques including biocatalysis

and other controlled polymerization methods the research unit aims to expand fundamental scientific knowledge towards advanced technologies.

The research unit consists of two staff members, Prof.dr. Katja Loos and Prof.dr. Giuseppe Portale, and around 20 group members (Postdoctoral fellows, PhD students, technical and secretarial support). The group has joint PhD students together with NHL Stenden in the scope of a Hybrid Research Group. Currently, one PhD student works in the field of wood plastic composites.

The research group Polymer Science is led by Prof. Kamperman and combines expertise in polymer synthesis, structure formation and bioadhesion. The group aims to use biologically inspired strategies to develop polymeric materials for next generation adhesives and functional materials. Besides the group leader the unit consists of 4 postdocs and 11 PhD students and technical and secretarial support.

6. Local and (inter)national position

In Groningen the main research groups related to the position are the two optional host groups (see above, groups Loos and Kamperman), and Product Technology (headed by Prof. Picchioni). Relations to other FSE institutes (e.g. ENTEG, Stratingh Institute for Chemistry) and the W.J.Kolff Institute at the medical center offer opportunities for research and education collaborations. Beyond the education and research at FSE, the position also links excellently to ongoing activities of the University of the North and the strong ties with local/regional societal themes like e.g. "Schone Noorden" or Green Industry as well as industrial agenda's like Chemport Europe and the current developments on Soft Advanced Materials (SAM). The recently started network organisation "Composietenplatform" in which the RUG participates (<https://wccs-platform.nl/>) will help the newly hired tenure track assistant professor to get embedded in the regional initiatives in the research field.

Given the current importance and promising future prospects of polymer-based composite materials for our society the research topic fits very well to a variety of Dutch Science Agenda (NWA) topics such as "Materialen- Made in Holland"; "Circulaire economie en grondstoffenefficiëntie: duurzame circulaire impact"; "Energietransitie" and "Meten en detecteren: altijd, alles en overall". It has strong links to the Topsectors Chemistry and HTSM.

The technical universities in Delft and Twente are nationally leading in the research of polymer-based composite materials, while internationally, among others Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Polymer Competence Center Leoben, and Virginia Tech University are leading in research on polymer-based composite materials.

7. Expected contributions to teaching

The education profile of the new position will be initially built around courses and bachelor/master research projects of the CH and CE programs. It is planned that the new faculty will directly start teaching in: (1) Macromolecular Chemistry, (2) Practical Macromolecular Chemistry, (3) Polymer products, (4) Product Technology, and preferably also (5) Bio-based Products. It is expected that the new faculty will develop a master course on composite materials, which is of interest for the CH, CE, ME or BME programs (In the latter one may think of e.g. tooth implants and options for research collaboration with UMCG-Kolff, 3D printed composite gels with options for collaborations with GBB/GRIP). Additionally, the candidate is expected to function as a central figure, connecting the research units working on polymers and composites in ZIAM and ENTEG and, as such, help in the supervision of CH and CE BSc and MSc students on joint projects. The equipment in the group Loos (see Research) is suited and has capacity for project-work by BSc and MSc students from a rather diverse background.

It is expected that the candidate will contribute to innovations in the teaching based on modern developments in teaching methods, like modes of instruction and student participation and modes of assessment. The candidate must of course not only teach courses that are already pre-defined, and it is expected that he/she will play an important role in improving currently running courses and developing new courses in the future. In addition, it is expected that the candidate will support developments on the program level, for instance as a member of a program committee.

In addition, it is expected that the candidate actively exchanges experiences and ideas with the wider teaching community, including through publications in science educational journals and through (international) exchange visits. The candidate will be required to apply for funding from relevant teaching scholarship programs (e.g. EIT, ErasmusPlus, local funds, or other options stimulating advances in teaching).

Of relevance to both education and research is that the topic of polymer-based composites fits excellently within the topics of Chemistry of Materials and Complex Molecular Systems of the Chemistry section and Complex Matter, Soft Matter and Fluids of the Physics section of the Sector Plan Beta. This topic also matches very well to the Mechanical Engineering section of the Sector Plan Techniek.

Beyond the regular teaching activities, the position offers also options for knowledge transfer in the context of executive programs related to Chemport Europe, University of the North, the Green Industry agenda and more.

8. Expected contributions to research

The research of the position will focus on polymer-based composite materials, preferentially bio-based composites, but properties will be investigated both at the microscopic and macroscopic scale. Plastics are increasingly replacing conventional materials, mainly due to their low production costs and their lower density. Fibers and other fillers can be added to plastics to improve their mechanical properties and hence their competitiveness with metallic materials. The use of such composite

materials has continued to show substantial growth due to desirable cost and performance characteristics. In addition, conventional equipment (extruder and injection molding machines) can be used to produce final parts using this kind of composite materials. More recent developments include smart composites: materials with added functional properties to enable sensing as well actuation.

The research mainly focuses on polymer-based composites and their properties, such as strength and stiffness. This depends strongly on the chemistry of the used materials, the employed processing conditions, the properties of the individual constituents, the adhesion between the fibers and matrix and on the orientation of fibers during processing. This newly created position will thus particularly focus producing and investigating the polymer composites and understanding and optimizing the composite material performances in relation to its composition. Facilities for executing experimental research are available in the labs of prof. Loos incl. a wide range of characterization equipment.

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 FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees in the area of education. The candidate will participate in relevant national and international organizations.