

## Faculty of Science and Engineering

**Profile report:** Mass Spectrometry for Analytical Biochemistry (Massa Spectrometrie voor Analytische Biochemie)

- Discipline: Mass spectrometry, Proteomics, Metabolomics, Multi-Omics
- Level: Tenure-track Assistant or Associate professor
- Fte: Full time (1.0)

### 1. Scientific discipline

Mass spectrometry-based proteomics and metabolomics are an emerging field and play a pivotal role in modern life-science, and clinical and pharmaceutical research. Mass spectrometry can deliver quantitative molecular profiles simultaneously for several thousands of proteins and metabolites. It is thus a versatile analytical platform that allows the study of post-translational effects, which provide complementary information to what can be learned from genomics and transcriptomics signatures. Proteomics and metabolomics profiles provide crucial information to advance our understanding of the molecular mechanism of biological processes, disease onset and development, healthy ageing, and drug action. As such, they are becoming fundamental contributors to personalized diagnostics and treatment. Further development of mass spectrometric instrumentation, as well as concomitant biochemistry methods for sample preparation, chemical and stable isotope labelling techniques, and other sample processing are required in order to explore the complex molecular constitution and interplay of molecular biological processes in more detail.

### 2. Vacancy

This position is opened by the Board of the Faculty (PT/gl/21/00288) and will be embedded in the Groningen Research Institute of Pharmacy (GRIP), research group Analytical Biochemistry (AB). The position falls within the framework of the career development program, 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see the link for the [criteria and conditions](#).

### 3. Selection committee (BAC)

Prof dr. H.W. Frijlink, Scientific Director GRIP, Chair of the Selection Committee.

Prof dr. E. Hak, Education Director GRIP

Prof. dr. P. Horvatovich, Professor of Computational Mass Spectrometry (Analytical Biochemistry)

Prof. dr. E.M.J. Verpoorte, Professor of Analytical Chemistry and Pharmaceutical Analysis (Pharmaceutical Analysis), Chair of the Board, GRIP.

Prof. dr. K. Taxis, Professor of Pharmacotherapy and Clinical Pharmacy (Pharmacotherapy, Epidemiology, and Economics); Program Director Master Pharmacy.

External member: Prof dr. C. Jimenez, Professor of Personalized Pharmaceutical Care (VU University Medical Center Amsterdam).

Student-member: Victor Pera, MSc student, Medical Pharmaceutical Sciences.

Advisors: H. Haagsma (HR advisor); dr. R.V. van Calck (scientific coordinator); Prof dr. I. Kema (Professor of Clinical Chemistry, in particular Neuroendocrinology and Oncology, UMCG); Prof. dr. B. Bakker (Professor of Pediatrics, in particular Medical Systems Biology, UMCG).

#### **4. Research area**

Mass spectrometry has become a well-established instrumental technique to study proteins and metabolites in complex biological and clinical samples. This analytical approach has experienced unprecedented development over the past 20 years, which has led to faster, more sensitive, and higher-resolution mass spectrometers. State-of-the-art instruments have the capability to provide more comprehensive proteomics and metabolomics profiles. These allow the study of the molecular mechanism of complex diseases such as cancer and chronic obstructive pulmonary disease, glycosylation pattern changes in autoimmune diseases, and characterization of protein pharmaceuticals (so called biologicals). They also facilitate the study of the distribution of intact drugs in tissue, the ability to monitor the dynamic changes of phosphorylation and other post-translational modifications (PTMs) altering cell signaling and protein activity, and the detection of changes in protein turnover rates and metabolic flux. Mass spectrometry has thus become an important contributor to identifying biomarkers for personalized diagnostics and treatment, as well as assessing treatment efficiency and disease recurrence. Quantitative proteomics and metabolomics profiles provide a valuable contribution to both clinical and life-science big data, and are playing a pivotal role in current and future life-science discoveries.

Proteomics and metabolomics research involve the development of mass spectrometry instrumentation, as well development of new sample preparation methods, chemical reagents, automatic sample handling workflows. Mass spectrometry techniques provide complex and large amounts of data, therefore the advancement of this technological platform requires joining efforts with bioinformatics and computer science in order to support the processing and analysis of collected data. The constant development of novel technologies opens up new opportunities such as development of new protein biopharmaceuticals, single cell proteomics, spatial and activity profiling of proteins and these open up new application areas in clinical and basic life-science research.

#### **5. Embedding: institute**

The Groningen Research Institute of Pharmacy (GRIP) is positioned within the Faculty of Science and Engineering (FSE) and physically located within the University Medical Centre Groningen (UMCG) of the Faculty of Medical Sciences (FMS); hence, in an ideal position to benefit from collaborations between the two faculties. Together with Medical Sciences, GRIP participates in the Research Institute GUIDE (Groningen University Institute for Drug Exploration). The research associated with this vacancy is thus foreseen to be relevant for both GRIP and GUIDE. Pharmaceutical and medical research within GRIP is highly multidisciplinary. It bridges clinical and biomedical sciences on the one hand and chemistry, mathematics (statistics) and physics on the other. The interaction

between the pharmaceutical sciences with these fundamental and clinical sciences offers excellent opportunities for cutting-edge research.

With this vacancy, GRIP's ambition is to further build on the scientific knowledge generated by its preclinical and clinical research groups (e.g. Molecular Pharmacology, Drug Design, Pharmaceutical Analysis, Nanomedicine and Drug Targeting, Chemical and Pharmaceutical Biology) and complement the research portfolio of these groups with novel mass spectrometric methods in various application areas, such as biopharmaceutical development, new drug target and biomarker discovery for cancer and respiratory diseases.

The candidate will be embedded in GRIP's research group Analytical Biochemistry (AB), which has as mission to perform research in analytical chemistry in the context of biomedical/clinical projects. Apart from its participation in GUIDE, where AB operates in the program Medicinal Chemistry and Bioanalysis (MCB; see further details in this [flyer](#)), there are many other collaborations within GUIDE and beyond, for instance, the European Research Institute of Biology of Ageing (ERIBA), as well as other research groups within FSE and UMCG. This provides a unique opportunity to access relevant and varied basic science knowledge in chemistry, animal facility, biobanks, sequencing and other research services and facilities, as well as physics, computer science, and statistics, and collaborate with ground-breaking life-science and clinical research units.

AB is tightly integrated with the Interfaculty Mass Spectrometry Center (IMSC) which is a joint research facility for FSE and UMCG. The IMSC and AB together host more than 20 mass spectrometers ranging from triple quadrupole, ion trap, state-of-the-art QTOF and Orbitrap mass spectrometers (see further details on the IMSC [webpage](#)), as well as a liquid handling robotic system and excellent sample preparation and biochemistry laboratory facilities. AB includes the group of Prof. Dr. Peter Horvatovich providing expertise in bioinformatics, computational mass spectrometry, pre-processing LC-MS(/MS) and mass spectrometry imaging data and multi-omics data integration. The group has an advanced computational infrastructure with dedicated large-scale storage and high-performance computing hardware. AB has built a strong collaboration network and developed strong research lines in proteomics and metabolomics biomarker discovery, and performs quantitative profiling of cell lines, tissues and various body fluids. AB collaborates intensively with several research groups within GRIP, UMCG and FSE on a wide variety of topics. AB and IMSC contribute with proteogenomics data integration, LC-MS(/MS) pre-processing and biomarker discovery in the activities of the Dutch X-Omics Infrastructure Initiative (X-Omics).

## **6. Local and (inter)national position**

In the Netherlands, research and education in the area of proteomics and metabolomics is carried out at the following research institutes and universities, such as the Vrije University (VU), Amsterdam University (UvA), Utrecht University (UU), Maastricht University (MU), ERASMUS Medical Center (ERASMUSMC), Radboud University (RU), Leiden University Medical Center

(LUMC), Leiden University (LU), Vrije University Medical Center/Amsterdam Medical Center (VUMC/AMC), UMCG and the Groningen Research Institute of Pharmacy of the University Groningen. The proteomics and metabolomics activities in the Netherlands are extensive and very diverse. Some highlights from these activities include the group of Prof. Dr. Albert Heck (UU), who focuses on topics such as top-down methods, protein cross-linking, phosphoproteomics and other PTMs, and the group of Prof. Dr. Manfred Wuhler (LUMC), who performs research on topics such as glycomics, metabolomics and mass spectrometry imaging. Prof. Dr. Connie Jimenez (VUMC/AMC) is active in clinical cancer research, Prof. Dr. Ron Heeren (MU) performs research on mass spectrometry imaging and Prof. Dr. Thomas Hankemeier at LU leads an established research group in metabolomics. Research areas within GRIP consist of Drug Design, Molecular Pharmacology, Pharmaceutical Analysis, and Chemical and Pharmaceutical Biology, all of which make extensive use of various mass spectrometry methods.

Research collaborations exist with the Groningen Research Institute of Asthma and COPD (GRIAC), Lifelines, the Groningen Data Science and Systems Complexity Center, X-Omics, Chemical Biology (Stratingh Institute), ERIBA, and various research groups at UMCG. In addition, AB has strong (inter)national collaborations and participates in the activities of the Chromosome-Centric Human Proteome Project, European Proteomics Association, Swedish Melanoma Cancer Moonshot Center (University of Lund), Antidoping Laboratory Qatar, and the universities of New York and Semmelweis University Budapest.

## 7. Expected contributions to research

The candidate is expected to develop, or have already established, an excellent **research line in mass spectrometry-based proteomics and/or metabolomics**. Furthermore, a proven ability to acquire external funding for (PhD) projects would be beneficial, as well as demonstrable experience in the management of a research group, dependent on career stage. Opening up new application fields, establishing collaborations with relevant industrial and academic stakeholders, and maintaining a level of funding to perform world-class research are also critical in this position. Examples for specific research lines within mass spectrometry-based proteomics and metabolomics are (but not limited to) single cell profiling, imaging mass spectrometry, top-down native mass spectrometry, biomarker discovery and validation, and PTM profiling. Research to develop novel mass spectrometry instrumentation for analysis of the molecular composition of complex biological samples and to establish and support pharmaceutical, clinical and basic life-science research applications within the candidate's research lines, is also of interest.

## 8. Expected contributions to teaching

The candidate is expected to coordinate and teach the Bioanalysis second year pharmacy bachelor course ([WBFA032-05](#)) and to contribute to teaching within the programs of the Pharmacy curriculum, such as Instrumental Analysis (2<sup>nd</sup> year BSc, code [WBFA005-06](#)), Academic Research & Communication Skills (BSc phase), courses in the Masters of Pharmacy and Medical Pharmaceutical Sciences. The teaching topics are related to analytical chemistry, biochemical

methods, mass spectrometry, proteomics and metabolomics instrumentation and their applications in basic life-science, pharmaceutical and clinical research. They will also be actively involved in the development of new courses and/or revision of existing courses. Coaching and supervision of bachelor, master and PhD-students are an essential part of the teaching tasks.

### **9. Expected contributions to the organization**

The candidate is expected to have an active interest in and provide a positive contribution to the management and organizational tasks of GRIP and FSE. Furthermore, 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 national and international organizations relevant to their research fields and teaching portfolio. The candidate is expected to hold the University Teaching Qualification (BKO) or to acquire it shortly following their appointment.