university of groningen

GBB

Faculty of Science and Engineering

Profile report: Microbial Biotechnology

- Disciplines: Microbial Molecular Biology, Microbial Genetics, Biotechnology
- Level: Associate to Full Professor
- Fte: Full time (1.0)

1. Scientific discipline

The era of modern genetic engineering was initiated between the 1950-1970s with solving the structure of DNA, deciphering of the genetic code, and elucidation of the molecular basis of genetic information transfer. Scientific breakthroughs have emerged ever since with prominent examples being the development of DNA engineering tools (including PCR), directed evolution, (next generation) sequencing, and more recently CRISPR/Cas for genome editing. Based on these developments, most of which originated in the academic community, numerous innovations in industrial biotechnology have been established. From the onset, microbial genetics has played a central role in this exciting field, which remains multifaceted and thus strong interactions between Academia and industry continue to exist.

2. Vacancy

A position for an associate to full professor in Microbial Biotechnology is opened at the Faculty of Science and Engineering (FSE) of the University of Groningen. This position will be embedded in the Groningen Biomolecular Sciences and Biotechnology Institute (GBB) and will be open to applicants with a (potentially) world-leading research line in any subfield of Microbial Molecular Biology, and who has the ambition to lead fundamental work into biotechnological applications. Also, a demonstrated academic teaching experience appropriate to the career stage is expected. The position fits well with the Faculty's strategy on Impact, and will strengthen the Biotechnology focus of the research institute GBB and the faculty. The position falls within the frameworks of the national sector plans Biology and the 'Career Paths in Science' ('Bèta's in Banen').

3. Selection committee

- Prof. Dirk Slotboom (Scientific Director, GBB), chair
- Prof. Dirk-Jan Scheffers (Director of Education, GBB)
- Prof. Giovanni Maglia (Professor in Chemical Biology, GBB)
- Prof. Tessa Quax (Associate Professor in Molecular Biology of Archaea and Viruses, GBB)
- Prof. Sahar El-Aidy (Associate Professor in Host-Microbe Metabolic Interactions, GBB)
- Prof. John van der Oost (Professor in Bacterial Genetics, Wageningen University)
- Nora Migdad (MSc student Biomolecular Sciences)

Additional (external) advisors:

- Ms. Mariska Laning (Human Resources, FSE)
- Dr. Engel G. Vrieling (Managing Director of GBB), secretary

4. Research area

Advances in methods to engineer microorganisms (for instance related to CRISPR/Cas, directed evolution and high-throughput screening) not only generate fundamental insight in mechanisms that define microbial life, but also lead to applications where this knowledge is used to obtain microbes with new or altered functionalities. This field has been particular successful in combining basic science with industrial applications and tech-transfer, for instance in the design and production of (novel) bioactive molecules, such as proteins (e.g. biosimilars), (secondary) metabolites, antibiotics or bioactive peptides, as well as simple organic molecules as platform chemicals.

Three partially interrelated subfields can be defined that fit well within the GBB strategy. First, the engineering of metabolic pathways to steer microbial cells towards the production of desired primary or secondary metabolites (such as dicarboxylic acids, antibiotics, and larger molecules including non-ribosomal peptides). While such metabolites could be of industrial relevance, the fundamentals of understanding, modelling and redesigning metabolism, is a typical academic challenge. Second, the genetic modification of microorganisms to optimize the biosynthesis of desired biomolecules. Proteins and peptides are the most meaningful group of new pharmaceuticals (e.g. biosimilars, antibodies, antimicrobials), are often needed in vaccines and in diagnostic tests, and are used in various consumer products (e.g. enzymes). Fundamental insight gained from the study of producing these molecules with microbial cells makes it an exciting academic research field. For instance, the optimization of production of stable proteins and protein complexes opens the way to study stress responses, quality control, molecular ageing, etc. Third, design of new enzymatic functions often go hand in hand with the development of screening methods that are required for efficient microbial genetic engineering. Also, here fundamental academic research and industrial applications are interwoven.

5. Embedding: institute (and base unit)

The position will be embedded in the institute GBB as an independent research unit (Molecular Genetics, or renamed Microbial Biotechnology). The envisaged expertise of the new professor will make it possible to cover the teaching activities currently carried out by the group (headed by Prof. Oscar Kuipers, who will retire in the coming years). The GBB institute has 13 creative research units, targeting challenging biological questions in the focal areas 'Molecular Mechanisms of Biological Processes' and 'Physiology and Systems Biology'. Depending on the research focus, the newly appointed staff member will be able to connect to studies in systems biology (Prof. Matthias Heinemann, Dr. Andreas Millias) and synthetic biology (Profs. Arnold Driessen, Roel Bovenberg, Oscar Kuipers, Gert Moll, Tessa Quax and Dr. Sonja Billerbeck). Furthermore, the work may connect to biotechnology and molecular enzymology (Prof. Marco Fraaije, Dr. Max Fürst), structural biology (Profs. Siewert Jan Marrink, Dirk Slotboom, Albert Guskov and Dr. Cristina Paulino), chemical biology (Profs. Giovanni Maglia, Bert Poolman, Gerard Roelfes), and research in the area drug development (Profs. Gerrit Poelarends, Alexander Dömling, Matthew Groves) at the Groningen Research Institute for Pharmacy (GRIP). The envisioned research also directly contributes to the actions in the FSE theme Molecular Life & Health.

6. Local and (inter)national position

The engineering of microorganisms for fermentative production processes, both of small molecules and of biomacromolecules (sometimes also referred to as synthetic biology or systems biology), or for fundamental research for instance on pathogens causing diseases in

humans, provides important connections between academic institutions and the Dutch and international biotechnology industry.

Outstanding international groups in biotechnological engineering are of Profs. G. Church (Harvard), J. Keasling (Berkeley), and J. Nielsen (Gothenburg). The most prominent activities in the Netherlands are taking place at the Delft Technical University (Profs. J. Pronk, J.-M. Daran) with excellent research in yeast and fungal metabolic engineering. Synthetic biology and metabolic engineering are also pursued at the Wageningen University (Profs. V. Martins dos Santos, P. Schaap; R. van Kranenburg, mainly bacteria) and Leiden University (Profs. G. van Wezel, N. Martin, actinomycetes and antimicrobials). Leiden University is also prominent in fungal metabolic engineering (Profs. P. Punt, A. Ram) with influential work on enzyme production in fungi. Engineering for studying pathogens and fundamental microbiology using CRISPR/Cas applications was pioneered by Nobel laureate Prof. E. Charpentier (Berlin) and in the Netherlands by Spinoza laureate Prof. J. van de Oost (Wageningen).

Most activities in this field are well connected to industry (for instance companies like Genentech, Ginkgo Bioworks, Biosyntia, Corbion, DSM, Christian Hansen, and Intervet), and it is likely that industrial involvement will continue to grow over the coming decades in view of urgent sustainability challenges and the need to develop bioresources for production of platform chemicals, polymers and bioactive compounds.

The fundamental biomolecular and microbial research in Groningen is very strong, but currently more restricted in terms of number of involved groups. Links to industry are excellent. For example, the work on NRPs and RiPPs was boosted through the activities of Prof. R.A.L. Bovenberg (DSM) and Prof. G.N. Moll (previously Lanthiopharma), respectively, who are honorary professors at GBB. Spin-off companies originating from GBB (e.g. CarbExplore, Gecco Biotech, Portal Biotech, and Omnicin Therapeutics) provide a successful local example of bringing fundamental knowledge to application.

7. Expected contribution to research

The new professor will conduct fundamental research resulting in publications appearing in influential internationally leading scientific journals. The research activities will contribute to the strengthening of the international position of the GBB as a research institute in biomolecular sciences and biotechnology. Furthermore, the research will lead to applications either in start-up companies or in collaborations with existing companies. Acquiring substantial external funding is vital, and it is encouraged that funding will partially come from industrial partners or investors. Supervision of PhD students is a crucial part of the research activities.

8. Expected contribution to teaching

The successful candidate will contribute to the relevant teaching programs of the bachelor, master and PhD programs of the Faculty of Science and Engineering, predominantly in Biology, Life Science & Technology and Biomedical Sciences, appropriate to the career stage. The requirements for the University Teaching Qualification will have to be fulfilled.

9. Expected contribution to the organization

An active input is anticipated in order to provide a valuable contribution to the management and organizational tasks of the institute GBB and the Faculty of Science and Engineering, appropriate to career stage. At the level of the faculty, the staff member may participate in

working groups and committees in the fields of teaching, research and management. The candidate is also encouraged to participate in relevant national and international science forums.