Faculty of Science and Engineering (FSE)

Profile report: Materials Chemistry (Chemie van Materialen)

- Discipline: Chemistry
- Level: Associate professor/ Full professor
- Fte: Full time (1,0)

1. Scientific discipline

Materials chemistry comprises the application of chemistry to the design, synthesis, characterization, processing, understanding, and utilization of materials, particularly those with useful, or potentially useful, physical (e.g. electronic, magnetic, optical, and mechanical) properties.

2. Vacancy

This position is opened by the Board of the Faculty (EMK/gl/16/01035) and will be embedded in the Zernike Institute for Advanced Materials. The position falls within the framework of 'Career Paths in Science 3' ('Bèta's in Banen 3'). Please see link for criteria and conditions
[http://www.rug.nl/fwn/organization/vacatures/vacatures/career-paths-in-science-edition-3]

3. Selection committee (BAC)

Prof. C.H. van der Wal, scientific director of the Zernike Institute for Advanced Materials and professor Physics of Quantum Devices (Chair)
Prof. B. Noheda, professor Nanostructures of Functional Oxides
Prof. P. Rudolf, professor Experimental Solid State Physics and director Graduate School of Science
Prof. S. Faraji, professor Theoretical Chemistry
Prof. E. Otten, professor Molecular Inorganic Chemistry, Stratingh Institute for Chemistry
Prof. B. Dam, External member, professor Materials for Energy Conversion and Storage, TU Delft
Student member

Dr. G.R. Blake (advisor, assist. prof. X-ray/Neutron Scattering and Spectroscopy)
Dr. J.P. Birkner (advisor, scientific coordinator Zernike Institute)
Ms. A. van der Woude (advisor, Human Resources)

4. Research area

Materials Chemistry applies chemistry to the design, rational synthesis and study of materials that have interesting and potentially useful electronic, magnetic, optical, or

mechanical properties. The focus, as we envision it, will mainly be on fundamental science, discovering and developing new materials using both existing and new synthetic methods. An important aspect of Materials Chemistry is understanding the structure-property relations (ranging from defect and unit-cell scales to nano- and microstructures) that are crucial for further advances.

Research in this area currently includes, but is not limited to, batteries and fuel cells, photocatalysis, energy conversion and storage, high efficiency electronic devices, hydrogen generation and storage, light-emitting materials, light-weight high-strength materials, and organic semiconductors. Such materials may be in the form of bulk ceramics, single crystals, and thin films. This type of research benefits from the significant use of advanced structural and physical properties characterization methods as well as nanoscience tools.

5. Embedding: institute and research group

The Zernike Institute for Advanced Materials is one of the leading institutes in the field of materials science. Our goal is to design, build and connect nanostructured and (bio)functional materials to achieve unprecedented functionality.
The strength of our institute lies in focused, curiosity-driven, symbiotic studies of functional materials involving researchers from physics, chemistry and biology. Our main driving force is the desire to understand how things work at the microscopic level down to the molecular and atomic 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.
Within the Zernike Institute more than 30 leading researchers address fundamental and challenging questions in the fields of functional materials that are relevant to societal problems, like e.g. energy, energy efficiency, health, and sustainable materials. Together with postdoctoral fellows, PhD students, technicians and other support staff, the Zernike Institutes' team comprises a total of about 250+ active researchers.

The Materials Chemistry group will be established within the Zernike Institute as a new research group succeeding the research group Solid State Materials for Electronics. We expect the current vacancy to strengthen our focus area 'nanostructured materials for electromagnetic functionality', by filling a gap in materials synthesis. For the multidisciplinary, synergistic nature of research in the Zernike Institute a continuation and further strengthening of materials chemistry is essential. The new group is expected to have strong interactions (but not strong overlap) with many other groups at the Zernike Institute who study complex materials, including (but not limited to) the following: The group of Nanostructures of Functional oxides (Noheda / Blake) studies nanostructured materials with electromagnetic functionality or energy harvesting properties. The group of Optical Condensed Matter Physics (Pchenitchnikov / vacancy) studies optical response including the use of time-resolved techniques. The Photophysics and Optoelectronics group (Loi / Koster) develops novel materials for solar cell and optoelectronic applications. The Surfaces and Thin Films group (Rudolf) studies new functional materials including nanocomposites, two-dimensional solids and hybrid materials. The

Physics of Nanodevices group (van Wees / van der Wal / Banerjee) focuses on spintronics and quantum devices often using novel materials and the group of (Kooi/Palasantzas) for nanostructure characterization using electron microscopy. The new group will also work closely with Theoretical Chemistry (Broer / Faraji / Havenith), who study complex materials using ab-initio and DFT-based techniques, and Theory of Condensed Matter (Mostovoy), which focuses on phenomenological theories of complex systems including skyrmion lattice materials and other complex magnetic order.

6. Local and (inter)national position

The Materials Chemistry group will occupy a rather unique position in the Dutch research system in its focus on curiosity-driven studies of advanced materials. Perhaps the most similar groups in the Netherlands are Solid State Chemistry at Radboud University (Vlieg), which concentrates mostly on the crystallography, morphology and chirality of inorganic and organic crystals but less on their physical properties, and Inorganic Materials Science at MESA+, Twente (Rijnders) which leans heavily towards thin film materials. Most of the other materials chemistry groups in the Netherlands can be described as having a more chemical engineering outlook and focus mainly on applied research. For example, the Inorganic Materials Chemistry group (Hensen) at T.U. Eindhoven is focused only on catalysis. The Materials and Interface Chemistry group there (Sommerdijk) concentrates on the applications of bio-inspired, "soft" materials. There is also a large materials chemistry group (Dam) at T.U. Delft, which is focused on energy storage and conversion (hydrogen and solar fuel, batteries).

Internationally, it is envisaged that the approach and outlook of the new Materials Chemistry group regarding curiosity-driven research on a range of different materials might become comparable with that of groups such as Cava (Princeton), Canfield (Ames Laboratory), Cheong (Rutgers), Rosseinsky (Liverpool), Maignan (CRISMAT), Tarascon (College de France), Attfield (Edinburgh), Felser (Max Planck Institute Dresden).

7. Expected contributions to research

The candidate is expected to initiate and develop a research program in the field of Materials Chemistry. The research should have a visibility on the national and worldwide level and lead to publications in top journals. 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.
Obtaining substantial external funding is crucial. Supervision of PhD students is an important part of the research activities. The research is expected to strengthen the existing efforts within the Zernike Institute in the field of materials chemistry and to take an international leadership role.

8. Expected contributions to teaching

The candidate is expected to contribute to the teaching -mainly for courses in the chemistry discipline- in the bachelor and master degree programs within the Undergraduate and Graduate Schools of Science and Engineering, as well as to the Top Master program Nanoscience, organized by the Zernike Institute. She/he is

expected to participate in the teaching program of specialized courses in relation to materials chemistry and other related topics.
Furthermore, the candidate will be involved in supervising bachelor, master and PhD students. Upon appointment, depending on experience and formal qualifications to date, the candidate may be required to enter a nationally standardized tertiary teaching skills certification trajectory, the University Teaching Qualification (UTQ) [in Dutch Basis Kwalificatie Onderwijs (BKO)], successful completion of which is a condition for promotion to a higher rank.

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.