

## Materials Science

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### Degree conferred

Scientiarum doctor in scientia materialium / Doctor of Philosophy in Materials Science (PhD)

### Commencement of studies

An application for admission may be submitted at any time.

### Regulation

<http://studies.unifr.ch/go/Pm-6g> (French and German only)

### Application procedure

#### Candidates with Swiss qualifications

<https://studies.unifr.ch/go/Ui3b4>

#### Candidates with foreign qualifications

<https://studies.unifr.ch/go/2KPbe>

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## Fribourg profile

The Adolphe Merkle Institute (AMI) currently employs around 50 PhD students who work in the five AMI research groups. The working language at the AMI is English and the PhD work comprises a personal research 3-4 year project within one of the research groups. The mentoring staff at AMI is devoted to instilling the doctoral candidates with the desire to perpetuate a tradition of high scientific quality. The state-of-the-art facilities provide students with the potential to acquire a whole range of valuable knowledge and skills over the course of their studies. The quality of the research equipment constitutes one of the major assets of the programme, as the trainees will be given the chance to master a high number of experimental techniques. The combination of interdisciplinary, outstanding infrastructures and educational commitment defines the attractiveness of AMI, making it one of the best places to study soft nanomaterials at the postgraduate level.

The institute strives to be a leader in this area and hosts both fundamental and application-oriented interdisciplinary research programmes. Our researchers are currently organised in five research groups, which offer complementary expertise and interests in strategically important areas:

### BioNanomaterials

The BioNanomaterials research group is co-led by **Prof. Alke Fink** and **Prof. Barbara Rothen-Rutishauser**. Prof. Fink leads the materials science aspect of the group and Prof. Rothen-Rutishauser is responsible for all biological studies. This situation is a fresh, novel, and exciting perspective upon scientific research in an academic setting, enabling the unification of two different scientific backgrounds in order to make a truly strong interdisciplinary research group. The interdisciplinary nature within the BioNanomaterials research group is further expressed by the varying scientific backgrounds of its members, which include chemistry and biochemistry, biology, pharmacy, biomedicine, materials science, and biophysics.

For more information: <https://www.ami.swiss/bionanomaterials/en/>

### Biophysics

The overarching research goal in the Biophysics laboratory, led by **Prof. Michael Mayer**, is to apply biophysics knowledge towards improving human health. To this end, his group contributes to the molecular understanding of disease by developing sensitive diagnostic assays and sensors, as well as characterising individual protein molecules for applications in biomarker detection, routine protein analysis, and proteomics. Research is multidisciplinary and collaborative and many projects take inspiration from nature to develop biophysical assays, methods, and tools that enable molecular-scale interrogations with unprecedented information content, sensitivity, and speed.

For more information: <https://www.ami.swiss/biophysics/en/>

### Macromolecular Chemistry

The research carried out by AMI's Macromolecular Chemistry group, led by **Prof. Nico Bruns**, is motivated by a fascination for polymers and proteins. The rationale behind our work exploits the various functions of proteins, such as their ability to self-assemble into well-defined three dimensional structures and to act as catalysts, and merges them with polymer systems, which are relatively easy to synthesise and can be tailored to specific applications. Via this approach, some of the best aspects of two different domains of macromolecular chemistry are combined in order to exploit the catalytic power of enzymes, to create novel nanosystems and to develop materials with unprecedented new functions.

Three lines of research illustrate our strategy:

- 1) Enzyme-catalysed controlled/living radical polymerisation (ATRPases);
- 2) Protein cages and polymersomes as nanoreactors;
- 3) Polymer-protein hybrid materials with the capability to self-report damage.

### Polymer Chemistry and Materials

Motivated by the desire to create novel (nano)materials that exhibit currently unavailable properties and enable new applications, the primary research focus of the Polymer Chemistry and Materials group led by **Prof. Christoph Weder** is the design, synthesis, and investigation of structure-property relationships of novel functional polymers. Many projects are inspired by Nature's materials, and/or utilise bio-based building blocks, such as cellulose nanocrystals. Interests and activities are interdisciplinary and range from the synthesis of new monomers and polymers, to advanced polymer processing, to the in-depth investigation and technological exploitation of materials with unusual but desirable properties.

For more information: <https://www.ami.swiss/en/groups/polymer-chemistry-and-materials/>

### Soft Matter Physics

How does the assembly of materials on the 10 nm to 1  $\mu$ m length scale determine its function? This question motivates most of the projects of the soft-matter physics group. Currently the two main topics encompass energy and optical materials. In the energy materials field, we investigate structure-function interplay in organic and perovskite based solar cells and in lithium-ion batteries. Optical

materials include plasmonic metals that are structure with the help of polymer self-assembly and bioinspired photonic bandgap materials. The latter is part of the strong focus on bioinspiration focus of the soft matter physics group that also includes surface properties of (nano-) structured materials such as wetting and adhesion, and mechanical properties (e.g. nacre).

For more information: <https://www.ami.swiss/physics/en/>

Interdisciplinary collaborations between our researchers are the basis for the successful and efficient execution of complex research projects that transcend the boundaries of traditional scientific disciplines.

Open PhD positions will be advertised on the AMI web-page. Unsolicited applications that are not targeting an advertised position will not necessarily receive a response.

## Studies organisation

### Structure of studies

No ECTS credits can be earned.

### Doctoral school

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### Admission

In order to be admitted to a doctorate the candidate must have been awarded an academic **bachelor's and master's degree** or an equivalent qualification from a university recognised by the University of Fribourg.

Before applying for a doctorate the candidate must contact a **professor** who would be willing to supervise the thesis work.

There is **no general right** to be admitted to a doctorate.

*The respective conditions of admission for each doctoral study programme are reserved.*

## Contact

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## Doc- Postdoc-portal

<http://www.unifr.ch/phd>