

Master of Science

# Battery Materials and Technology

*A comprehensive approach to battery  
research and technology*





*Set your own focus during your studies. The modules allow you to individually specialise along the entire value chain of batteries with all its diverse scientific and technological challenges.*

## Batteries are a key technology for the 21<sup>st</sup> century.

Access to sustainable and renewable energy represents one of the great challenges for the world in the 21<sup>st</sup> century. Therefore, electrochemical energy storage, in particular batteries, will be an essential tool for the future. What will be battery materials for more efficient batteries, which materials will be more sustainable for our environment? How we can make batteries safer and produce them cheaper? The Master's degree programme *Battery Materials and Technology* will prepare its students for these future challenges. It is taught in English albeit the students can participate in modules from the sister programme *Batterietechnik* that is taught in German and has a strong engineering background. The programme has a scientific orientation and is also well suited for applicants that want to pursue a PhD as follow up. Both programmes address the fundamental and applied questions of energy storage and obtain qualifications that are currently in very high demand on the job market.



*At the Bavarian Centre for Battery Technology (BayBatt), the University of Bayreuth researches and develops intelligent, networked, and sustainable energy storage systems, such as batteries in electric vehicles, buildings, and grids – i. e. mobile as well as stationary applications.*

## Develop the next generation of batteries.

A current estimate for the global demand of batteries for electric vehicles, stationary storage, and consumer electronics assumes an increase by a factor of nearly 15 by 2030. This enormous growing demand is leading currently to a massive expansion of production capacities throughout Europe and the rest of the world, requiring many more highly-qualified specialists with the necessary battery know-how for the entire value chain: from the electrode and separator materials to the battery pack in the e-car. These are excellent prospects for you, because your Master's degree equips you for exciting tasks in industry and science. The Master's degree programme benefits from the close connection to the *Bavarian Centre for Battery Technology (BayBatt)* where the University of Bayreuth is conducting intensive research from battery materials and analytics to intelligent, networked, and sustainable energy storage systems for the future.

# Combine integrative thinking and specialization.

Interdisciplinarity is a trademark of the University of Bayreuth, and it is reflected in the *Battery Materials and Technology* degree programme. To get a well-founded understanding of battery technology, you will first acquire a basic knowledge of Chemistry, Materials Science and Electrical Engineering. You can then further expand your knowledge in areas that particularly interest you. You will gain experience in research and laboratory practicals, and put your knowledge into practice in the advanced seminar while always remaining in close contact with battery research in the field. The master's thesis will complete your studies. The interdisciplinary concept of the degree programmes also allows you to switch between the faculties. The degree programme *Battery Materials and Technology* is closely interlinked with the Faculty of Biology, Chemistry and Earth Sciences, but also the Faculty of Engineering Science.

## Your degree programme at a glance – 4 semesters duration.

Individual Alignment Modules A–C	ECTS*
Mathematical fundamentals for electrochemical energy storage systems	5
Physical fundamentals for electrochemical energy storage devices	5
Basics of inorganic chemistry for electrochemical energy storage systems	5
Physicochemical fundamentals for electrochemical energy storage devices	5
Macromolecular/Organic chemistry for electrochemical energy storage devices	5
Electrical engineering fundamentals for electrochemical energy storage systems	5
Fundamentals of mechanical engineering for electrochemical energy storage systems	5
Fundamentals of materials science for electrochemical energy storage systems	5
<b>3 alignment modules must be taken</b>	<b>15</b>

Mandatory Modules	ECTS*
Battery systems technology 1	5
Battery materials 1	5
Electrochemistry 1	5
Battery systems technology 2	5
Battery materials 2	5
Electrochemistry 2	5
Seminar	5
	<b>35</b>
Elective Modules A, B, C	ECTS*
Natural Science	
Electrochemistry	5
Operando Analytics of electrochem. energy storage systems	5
Anorganic active materials f. electrochem. energy storage	5
Polymer materials for electrochemical storage	5
Technical chemistry: sustainability and material cycles	5
Physical Chemistry	5
Inorganic Chemistry	5
Macromolecular Chemistry	5
Theoretical Physics	5
<b>2 compulsory elective modules must be taken</b>	<b>10</b>
Engineering Science	
Electronics of electrical energy storage systems	5
Systems engineering of electrical energy storage systems	5
Electrode design of electrochem. energy storage devices	5
Cell design of electrochemical energy storage systems	5
Electrical energy systems	5
Functional materials	5
Materials process engineering	5
Battery management methods	5
Business information systems & sustainable IT management	5
<b>1 compulsory elective module must be taken</b>	<b>5</b>
Research Modules	ECTS*
Research Module 1	10
Research Module 2	10
Research Plan	5
	<b>25</b>
Master thesis	ECTS*
Master thesis	30
	<b>30</b>
<b>Total</b>	<b>120</b>

\*ECTS Credit points according to ECTS. The awarding of credit points (LP) according to the European Credit Transfer System (ECTS) supports the international comparability of academic achievements at European universities.



Once all students reach the required level of knowledge, they complete the interdisciplinary modules “Battery Materials” and “Battery Systems” to gain a holistic understanding of the battery. They will also deal intensively with the electrochemistry of batteries.

## Why you should study in Bayreuth.

Together with the german-language degree *MSc Batterietechnik* the *Battery Materials and Technology* degree programme is unique in Europe and benefits from its close link to the *Bavarian Centre for Battery Technology*. The University's central scientific institution combines battery-specific know-how and drives the interdisciplinary research and development of battery storage systems. It maintains close contact between research and study at the interfaces of materials science, electrochemistry, engineering, information technology and economics. In national and international rankings, the University of Bayreuth regularly receives top ratings in terms of student support.

You can expect a varied and intensive course of study, state-of-the-art equipment, and a personal atmosphere between students and lecturers.



Our campus is the heart of the University. This is where friendships begin, collaborations start, and ideas take life. There is also a wide range of activities, such as film screenings, art exhibitions, theatre performances, music events, the annual UniOpenAir and much more.

## Study conditions that achieve top marks in the rankings.

The University of Bayreuth has around 13,500 students. It is characterized by its friendly campus. Walking distances are short, and you will quickly get to know students from other disciplines.

Student life promises great variety even outside the lecture halls. You can get involved in a variety of student organisations or take advantage of the extensive range of university sports. There are also regular film screenings, art exhibitions, theatre performances, numerous music events, and the annual Uni OpenAir on campus.

In addition, the City of Bayreuth offers good housing at reasonable prices and a low overall cost of living. The leisure activities in town, in the Fichtelgebirge mountains, and the Franken Jura are also extremely attractive.



UNIVERSITÄT  
BAYREUTH

### **An attractive degree programme awaits.**

We are pleased that you are interested in the master's programme in *Battery Materials and Technology* at the University of Bayreuth. You can enrol for the winter or summer semester. For admission, you need a bachelor's degree in a natural science or engineering subject. Basic knowledge of mathematics and physics is essential, as is basic knowledge of general chemistry. Suitable applicants will take part in a selection procedure.

### **Programme Coordinator**

Prof. Dr. Georg Papastavrou  
Chemistry Department  
University of Bayreuth  
95447 Bayreuth

### **Any more questions?**

Dr. Julia Menzel  
University of Bayreuth  
*Bavarian Centre for Battery Technology (BayBatt)*  
95440 Bayreuth  
Phone: +49 (0)921 55-5877  
baybatt@uni-bayreuth.de

### **More information**

[www.uni-bayreuth.de/en](http://www.uni-bayreuth.de/en)  
[www.baybatt.uni-bayreuth.de/en](http://www.baybatt.uni-bayreuth.de/en)  
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