Battery research at NAFUMA

The fabrication and implementation of batteries for the sustainable future are essential tasks. That has been recently reflected by a rapidly growing interest in Norway for the creating factories, which will contribute to the European battery market. The Department of Chemistry at UiO not only contributes to these efforts, but also performs the development of new battery materials and new chemistries for batteries of the future. At NAFUMA group we have laboratories fully equipped for the synthesis of new battery materials as well as for their evaluation in batteries. Our primary interests span from synthesis of cathode and anode materials for Li-ion and Na-ion batteries to their application in real batteries. As a master's student in the battery group, you will find opportunities to focus on the topic of interest, which fits your background, research interests and future career perspectives.

As a master's student in a battery group, you will start with getting familiar with the battery chemistries and infrastructure available to the group. You will also learn about the materials currently used in batteries and materials for the batteries of the future, how batteries operate and how to make them better. The other group members and your mentor(s) will be available to help you in the laboratory

environment and within the selected project. Our goal is to help you to become an independent researcher ready for the next step of your career. As a result of your work a written a written thesis will be produced and, depending on your result and efforts will be published in the scientific journals.

Below you will find several topics in the field of battery materials, which are available at NAFUMA group:

0D, 1D and 2 D conversion materials for Li-ion and Na-ion batteries: influence of the shape of nanostructures on the material's performance in batteries. The project will be focused on synthesis, electrochemical and structural evaluation of ZnS nanostructures as a model system. ZnS is one of the materials for Li-ion and Na-ion batteries which operates through a conversion mechanism (undergoes a chemical transformation with a formation of two separate phases during lithiation/sodiation). That property makes these materials not only appealing for potential application, but also for development of the fundamental understanding of their behavior at nanoscale.

Solid-state batteries: electrolytes and interfaces: solid-state batteries are viewed as the next generation of battery technologies delivering opportunities for new materials and enhanced performance and safety. However, the key component of solid state battery – solid electrolyte requires not only fundamental development but also development of the chemical processes which will help to implement the promising electrolytes into a functioning battery. Depending on the candidate's interests, the project will be focused on either inorganic or polymer electrolyte systems: their synthesis and implementation in batteries.

Chemical prelithiation of anode materials: for a number of promising materials to be used in anodes of modern Li-ion or Na-ion batteries, prelithiation (i.e. suppling extra Li prior the electrochemical evaluation) is an important process. The project will be focused on the development of the chemical methods, which will allow to supply Li into active materials for anodes, and will be accompanied by relevant structural and electrochemical characterization. The development of this chemistry is essential not only for batteries but for Li-ion and Na-ion capacitors as well.

Si-based conversion materials through chemical reduction: Si and Si-based materials are extremely important for Norwegian industry and Norwegian battery industry in particular. However, the majority of methods for synthesis of such materials are developed for industrial scale and not suitable for flexibility in chemical compositions necessary for the materials optimization or studies of new materials. The potential candidate will explore chemical pathways of synthesis of Si-based materials suitable for Li-ion batteries and evaluating those in the real batteries.

Multivalent systems - Ca-ion batteries: the batteries based on multivalent systems are considered to be batteries of the future. Being a rather new approach, the batteries based on multivalent systems lack the materials which will be capable of delivering significant lifetime combined with performance. To address these issues the project will be focused on development of anodes for Ca-ion batteries. That will include synthesis and electrochemical chacterization.