MATERIALS FOR ENERGY STORAGE – MATERIALS SCIENCE, PROCESS KINETICS, MATERIALS CHARACTERIZATION

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One of the most urgent problems that have to be solved in the near future is the energy problem and the environmental impact resulting from fossil fuels. Several storage technologies relying on new materials are under investigation. The goal of the lecture is to provide knowledge about functional materials used in electrochemical devices like batteries and fuel cells, and to explain the role of advanced materials for performance and lifetime of storage systems. The overview will include metallic lithium-based materials for batteries and nano-sized oxide powders for hydrogen storage.

The focus of this lecture will be primarily on materials solutions for storage systems that fulfill multiple requirements. The interdisciplinary character of materials research and development for batteries and fuel cells is demonstrated. The close interaction between device, technology and materials is shown. In particular, analytical techniques for in-situ materials characterization that image the kinetics of the storage process are included. The role of materials science and engineering for the development of storage systems is explained.

For the transition to an environmentally clean energy production from renewable sources it is expected that hydrogen will become one of the dominating energy carriers. In this lecture, several storage technologies relying on new materials are discussed, like metal hydrides and carbon based materials. The approach which is based on a cyclic redox reaction $3Me+4H_2O \leftrightarrow Me_3O_4+4H_2$) is explained in particular. The role of materials science to achieve the requested storage capacity after repeated storage cycles will be explained. In addition to solid-state physical results, conclusions for the hydrogen storage technology will be reported.

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