MM 32: Functional Materials IV

Time: Wednesday 11:30–12:30 Location: H 0106

MM 32.1 Wed 11:30 H 0106

Studying the lithium deintercalation in thin $LiCoO_2$ films by electro-chromatic measurements — •Tobias Stockhoff, Tobias Gallasch, Frank Berkemeier, and Guido Schmitz — Westfälische Wilhelms-Universität Münster, Institut für Materialphysik, Münster (Westf.), Germany

$LiCoO_2$ powder is one of the important components of today's lithium ion battery technology. In this work, we investigate thin $LiCoO_2$ films with respect to the intercalation/deintercalation of lithium ions, for potential application in all solid-state thin film batteries. For this purpose, $LiCoO_2$ films between 5 and 400 nm in thickness, were deposited onto ITO-coated glass substrates by rf-ion beam sputtering. The structure and stoichiometry of the films was checked by means of transmission electron microscopy (TEM), while basic electrochemical properties of the layers were studied by chrono-amperometry, cyclic voltammetry (CV), and galvanostatic intermittent titration technique (GITT).

Additionally, the reversible intercalation and deintercalation of lithium is demonstrated by measuring the optical transmission through the thin film system, since the colour of the $LiCoO_2$ films strongly depends on their lithium concentration. Using this electro-chromatic effect, the diffusion coefficient of lithium inside the films is determined, and the local lateral distribution of lithium is studied in-situ, using optical microscopy.

MM 32.2 Wed 11:45 H 0106

TEM on electrochemically cycled thin film electrodes — •Tobias Gallasch, Frank Berkemeier, and Guido Schmitz — Institut für Materialphysik, Westfälische Wilhlems-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany

Thin film electrodes (150 nm) of well known Li intercalation materials, such as $LiCoO_2$ and V_2O_5 are prepared by ion beam sputtering. XRD, analytical TEM (TEM/EELS) and conductivity measurements were employed to carefully optimize the sputter parameters. The functional efficiency of the thin films as battery material was verified in detailed Cyclic Voltammetry and Chrono-Potentiometry studies. In the case of V_2O_5 thin films high capacities (300 mAh/g after 25 voltammetric cycles) and high cycling stabilities (250 mAh/g at constant current, 1C) are found which are in the range of the theoretical capacity (400 mAh/g).

In contrast to conventional capacity studies at bulk material, we provide a model system with defined geometry which allows investigating fundamental Li transport and electrode aging processes on smallest length scales. Special focus is therefore dedicated to electron energy loss-spectroscopy (EELS) which is demonstrated to be sensitive to even minor changes in composition. V_2O_5 thin films show a crystalline to amorphous transition during cycling which is studied in detail by analytical and high resolution TEM. The goal of this work is the combination of both, electrochemical and structural data to obtain information about Li transport mechanisms which are of fundamental interest in this field.

MM 32.3 Wed 12:00 H 0106

Synthesis of metastable transition metal compounds for electrochemical energystorage — •Carsten Jähne[1], Christoph Neef[1], Hans-Peter Meyer[2], and Rüdiger Klingeler[1] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, 69120 Heidelberg — [2]Institut für Geowissenschaften, Universität Heidelberg, INF 236, 69120 Heidelberg

Advanced cathode materials for Lithium-Ion batteries are currently under intense research. We apply microwave-assisted hydrothermal reactions which enable synthesizing materials with a huge variety of morphologies and with grains down to the nanoscale. Here we report on the synthesis of two metastable materials LT-$LiCoO_2$ and non-olivine $LiCoPO_4$. We note that the latter exhibits a theoretically predicted crystal structure not observed yet in experiment. Crystal structure, morphology and Co-valancies were determined by means of XRD, SEM and magnetisation studies, respectively. The thermal stability of $LiCoPO_4$ was investigated with DSC/TGA. The electrochemical behaviour of both materials was analyzed by cyclic voltammetry (CV) and charge-discharge-cycling (GITT).

MM 32.4 Wed 12:15 H 0106

Aerographite: A new carbon nanomaterial with densities below 0.2 mg/ccm and outstanding mechanical properties — •Arnim Schuchardt[1], Matthias Mecklenburg[2], Yogendra Kumar Mishra[1], Sören Kaps[1], Rainer Adelung[1], Andriy Lotnyk[3], Lorenz Kienle[3], and Karl Schulte[2] — [1]Institute for Materials Science, Functional Nanomaterials, University of Kiel, Kaiserstr. 2, D-24143 Kiel, Germany — [2]Institute of Polymers and Composites, Hamburg University of Technology, Denickestr. 15,D- 21073 Hamburg, Germany — [3]Institute for Materials Science, Synthesis and Real Structure, University of Kiel, Kaiserstr. 2, D-24143 Kiel, Germany

Energy storage application like batteries or supercapacitors call for new carbon electrode materials which can be designed with respect to the requirements of the individual application. We will present our work about a new Carbon nanomaterial called Aerographite which has the lowest density of all materials yet known (density < 0.2 mg/ccm) but is still mechanically robust and highly flexible. The foam like hierarchical 3D network structure has been investigated by various methods like SEM, TEM, XRD and EELS and based on the results a growth model was developed. It will be reported about the synthesis of Aerographite and its potential to design the material in the desired manner for the individual application. Further on, measurements regarding the electrical conductivity and the mechanical tensile/compression behaviour will be discussed. Experimental results of an Aerographite electrical double layer capacitor will be elaborated in more detail.