Type of presentation: Poster

IT-2-P-5974 High quality FIB lamella preparation for wide area atomic resolution TEM investigations

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A large increase in research efforts on thermoelectric power generation is currently occurring because of the improved properties of various nano structured thermoelectric materials. NaXCoO2 is a thermoelectric material which for example makes the recovery of the waste heat emitted by vehicles and factories possible. In addition it can be used in electronic processors. The single phase NaXCoO2 crystals we are working with are grown by pulsed laser deposition on Al2O3 (001) or LaAlO3 (001). To improve this material transmission electron microscopy (TEM) investigations are indispensable. Especially for structures that reveal a lot of inhomogeneity it is necessary to have high quality focussed ion beam (FIB) TEM lamellas for wide area atomic resolution.
During our research we continuously improve the FIB preparation process. Because of the hardness of the sapphire substrate it is necessary to thin the lamella from the substrate side (shadow FIB). Especially when working with very ion beam sensitive structures this preparation technique is also very interesting for other materials, like even organic material.
In Fig. 1 a high angle annular dark field (HAADF) scanning transmission electron microscopy (STEM) image of a cross sectional TEM lamella is shown. This lamella consists of the Al2O3 substrate, the NaXCoO2 layer, a Pt protection layer to avoid oxidation and a W protection layer deposited in the FIB. The bright areas within the NaXCoO2 layer are CoO2 impurities.It gets obvious that the thickness of the lamella does not change significantly over the whole field of view with the width of approximately 4µm. Thus, a good overview of a big sample region showing different features can be created using FIB. In Fig 2 a high resolution HAADF STEM image of the same lamella is presented, showing the interface between the substrate and a CoO2 impurity. It can be seen, that FIB preparation is a useful method to obtain thin samples over a wide range. This enables in combination with (S)TEM the characterization of samples containing a lot of inhomogeneities. This presentation will summarize the necessary steps to optimize the FIB preparation to obtain optimal samples.

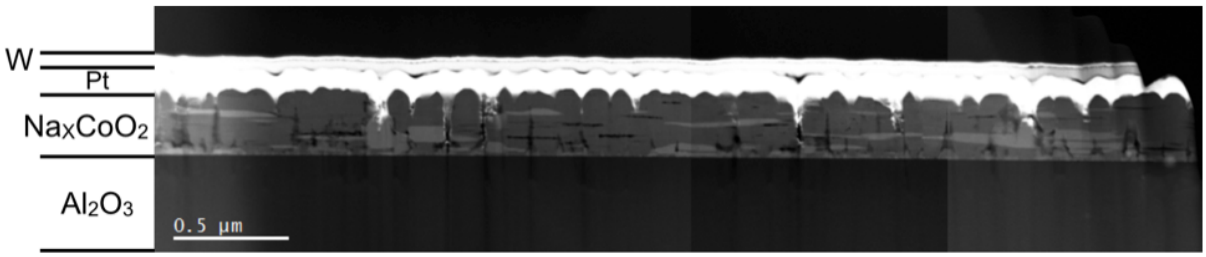

Fig. 1: HAADF STEM image of NaXCoO2 grown on Al2O3 with a Pt + W cap layer.

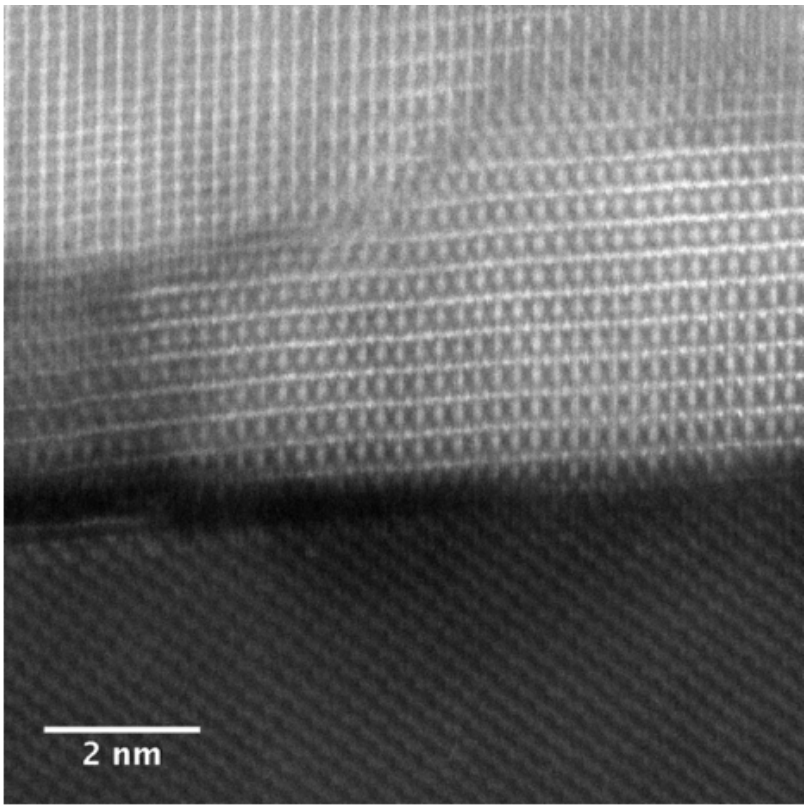

Fig. 2: High resolution HAADF STEM image of a CoO2 impurity on Al2O3 substrate.