MESA+
INSTITUTE FOR NANOTECHNOLOGY
NanoLab Twente

TEM EXAMPLE

XTEM of a very thick piezoelectric film

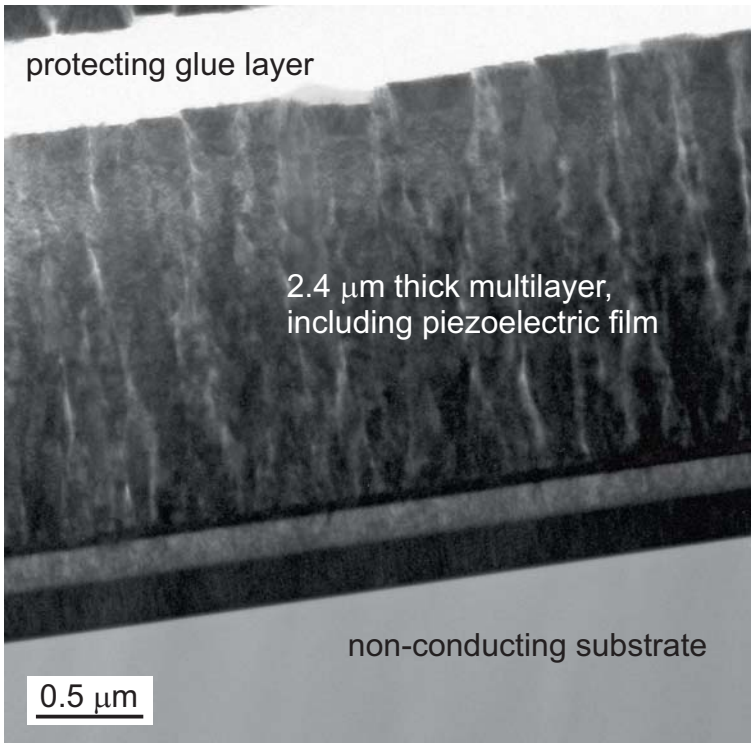

Fig. 1: XTEM view obtained by Dimple Grinding / Polishing and argon ion milling. The thinnest section is in the top area of the film. However, as the substrate is approached the specimen thickness increases progressively (darker). Additional ion milling would be needed to thin this region, however, at the cost of loosing the top area of the film.

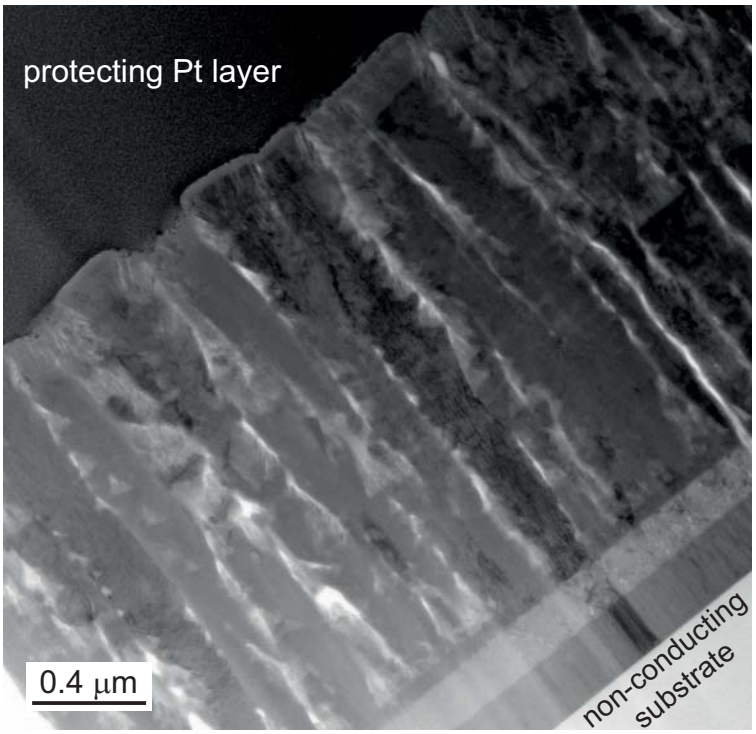

Fig. 2: TEM cross-section of the same sample as shown in Fig. 1, now created by the technique of Focused Ion Beam. The BF TEM image shows homogeneous electron transparency across the entire film thickness, with good contrast.

This example shows a cross-sectional view of a very thick film stack mainly composed of a piezoelectric material.

The substrate is electrically non-conductive, and may therefore cause serious charging problems during the analysis when the specimen is exposed to a beam of high-energetic primary electrons in the TEM.

The researcher who designed this sample was interested in the morphology of the piezoelectric multilayer. For that purpose a TEM specimen was made for cross-sectional observation (XTEM). One aspect was to study the quality at the interface substrate/film at sub-nanometer scale. For that purpose high-resolution TEM lattice imaging - at very high magnification - had to be performed on an area with the appropriate electron transparency.

However, to get a first impression of the film quality of such a sample at longe range order, it is mandatory to do also TEM imaging in the lower (lowest) magnification range. In this way a good overview of both the film across the entire layer thickness (here ~2.4 μm), and along the substrate can be obtained.

In this application note we test whether Dimple Grinding / Polishing and argon ion milling is suitable to thin samples with very thick films. The results are compared with Focused Ion Beam. See Figs. 1 and 2 for a comparison. It can be seen that TEM specimen preparation by FIB is the preferred method for samples with very thick films (> 500 nm), resulting easily to a homogeneous thin specimen across the entire film thickness (2.4 μm).