4.5 Combined Polarization and Scanning Force Microscopy

(L. Eng and I. Brüngger)

In order to record correlated information on both the micrometer and the nanometer scale on ferroelectric crystals we combined both a polarization microscope and a scanning force microscope (SFM) within the same set-up. This combination allows to relocate a desired surface spot with the accuracy of an optical telescope (10 µm resolution) which is much less than the normal size of a ferroelectric domain at the sample surface.

The SFM is designed to work both in gaseous and liquid environments. Specifically the use of organic liquids (such as liquid crystals, etc.) is possible in order to visualize antiparallel domains (180° domain walls) with the polarization vector being perpendicular to the sample surface. Cantilever deflections are sensed by the conventional beam deflection set-up. In order to obtain surface pictures of up to 100 x 100 μm^2 in size, it is the sample which is scanned using a piezo tube scanner module. For polarization microscopy an optical fiber enters into the piezo tube scanner, passes a polarization filter and then illuminates approximately 1 cm^2 of the optically transparent sample mounted on top of the scanner. To record the transmitted light, a beam splitter is introduced within the optical path of the beam deflection set-up. After passing a polarization analyser the data is displayed on a monitor. Polarization and SFM micrographs are therefore simultaneously recordable. Furthermore the sample may be heated up to 100° C in order to induce phase transition in to the paraelectric phase.

The set-up was successfully tested using tri-glycine sulphate (TGS). In order to visualize the 180° domain walls, liquid crystal decoration of the sample surface was chosen which induces enough image contrast for our optical system.