

Non-contact Scanning Nonlinear Dielectric Microscopy with sub-nanometer height resolution

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Recently, we have proposed and developed two types of Scanning Nonlinear Dielectric Microscopy (SNDM) which can obtain the dielectric properties on dielectric materials^[1]. The contact-type SNDM can measure the distribution of linear and nonlinear dielectric constant with sub-nanometer resolution^[2]. The non-contact-type SNDM (NC-SNDM) can characterize both the topography of dielectric materials and the dielectric constant distribution by detecting the nonlinear dielectric signal which is highly sensitive to the gap between a tip and specimen^[3]. However, the resolution of a present NC-SNDM was several nanometer order though atomic order resolution was expected from the calculation results. This low resolution was from the influence of the absorbed water in atmospheric measurement condition. In this paper, we will improve the NC-SNDM system and present NC-SNDM images obtained under the different vacuum conditions.

Figure 1 shows NC-SNDM image of c-c domain boundary on polished multi-domain LiTaO₃ single crystal obtained under 5.0×10^{-2} Torr. And NC-SNDM can measure the bumps of about 2 nm height which corresponds to the polarization direction. In figure 2 was presented the topography of atomically smoothed LiNbO₃(0001) obtained by the NC-SNDM under the ultra high vacuum condition of 3.2×10^{-10} Torr. This LiNbO₃ is obtained by atmospheric annealing process^[4] and has the step structure of 0.2nm height.

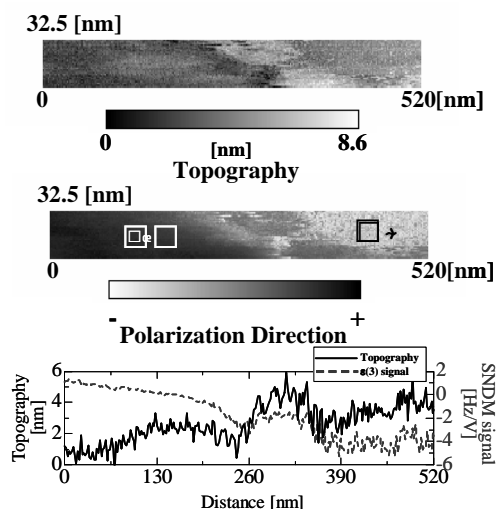


Figure 1 NC-SNDM images of LiTaO₃

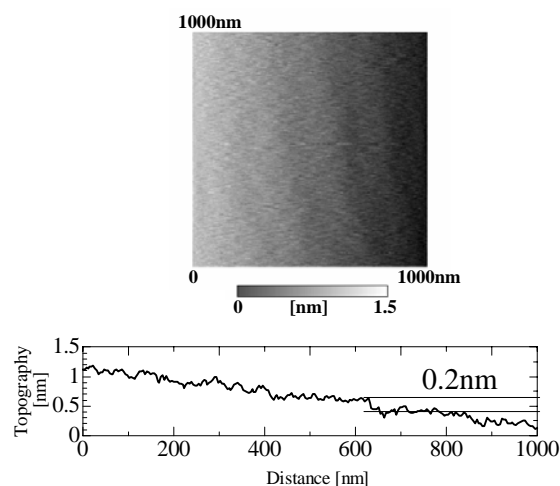


Figure 2 NC-SNDM image of step structure on LiNbO₃ (0001)

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