

Three-dimensional measurement of ferroelectric polarization using 3D-type scanning nonlinear dielectric microscopy with an electric field correction

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Recently, ferroelectric materials have attracted a lot of attention in various fields such as FRAM and ultra-high density data storage^[1]. Measurement of the ferroelectric polarization distribution is very important subject of research. We have developed a Scanning Nonlinear Dielectric Microscopy (SNDM) which can observe the polarization distribution with sub-nanometer resolution^[2]. SNDM can measure the polarization component perpendicular to the surface by applying electric field in the perpendicular direction. Moreover, we have succeeded in observing the polarization component parallel to the surface by applying electric field in the parallel direction^[3]. In this paper, we developed a new system that makes more exact measurement of polarization component parallel to the surface by correcting the normal component of electric field. Using this new system, the polarization distribution of periodically poled LiNbO₃ (PPLN) in three-dimension was observed. Figure1 shows the system diagram of the newly developed 3D-type SNDM. Figure2 shows polarization direction in PPLN. Figure3 (a) and (b) show SNDM images which describe the perpendicular and parallel polarization components to the surface. Thus, we succeeded in determining the three-dimensional polarization direction.

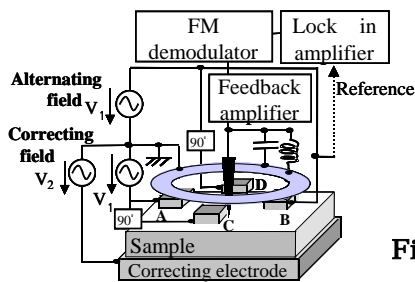


Fig.1 System diagram of 3D-typeSNDM

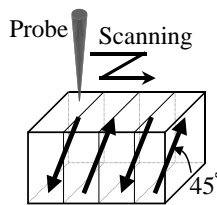


Fig. 2 PPLN Structure

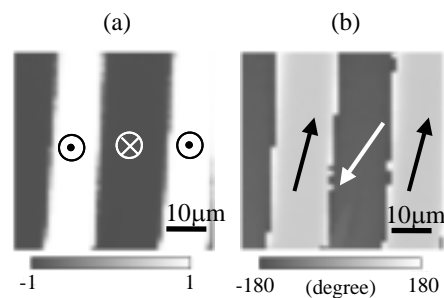


Fig. 3 SNDM images of polarization components

(a)perpendicular and(b)parallel to the surface

[1] Y.Cho,K.Fujimoto,Y.Hiranaga and Y.Wagatsuma, Appl.Phys.Lett,**81**(2002)4401

[2] H. Odagawa and Y. Cho,Surf.Sci.**463**(2000)L621

[3] H. Odagawa and Y. Cho, Appl.Phys.Lett,**80** (2002)2159.