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Interfacial Structure Analyses of Metal Oxide Heterostructures

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Structural information is fundamental to understand the physical properties of material from a microscopic point of view. In particular, metal oxides show various properties having a close relationship with their structures, such as electric polarization. In order to fully understand the property of heterostructures, one has to know the structure around the interfaces.

Surface x-ray diffraction method is a powerful tool to study the interfacial structures. It allows us to perform a non-destructive measurement of the atomic positions in sub-angstrom precision. Recent development of the analyzing method makes it possible to clarify the interfacial structure of metal oxides. Sharp termination of the electron density at the surface produces rod-shaped scattering intensity distribution, which contains detailed near-surface structure. Figure 1 shows one example of the surface x-ray scattering profile from the interface between the $LaAlO_3$ and $SrTiO_3$ along the 00ζ-line [1]. Sharp peaks at integer ζ positions are the Bragg reflections from the substrate $SrTiO_3$, and the intensity other than the Bragg peaks reflects the structure of surface and the interface. Using an aid of modern holographic analysis, we have successfully obtained the structure of the interface as shown in Fig.2. The result shows not only the difference in lattice spacing in the both sides of the interface but also atomic interdiffusion and the electric polarization as a function of the depth. The conductive property of this interface is examined by the structure.

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[1] R.Yamamoto *et al.*, Phys. Rev. Lett. **107** 036104 (2011).

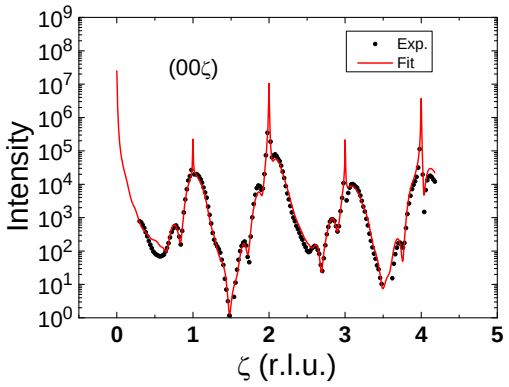

Fig.1: X-ray diffraction signal along the (001)-line of LaAlO3/SrTiO3 interface.

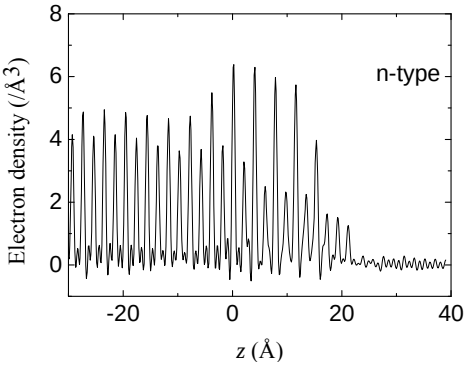

Fig.2: Electron density profile derived from Fig.1 through a holographic analysis. Each peak represents atomic positions.