Valence band observation of the quasi-crystal surface by two-dimensional photoelectron spectroscopy

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1. Introduction

It is believed that very low conductivity of quasicrystal and a large reduction of electron density (pseudo gap) at the Fermi level are related. The sphere like Brillouin zone boundary interacts strongly with the Fermi surface, and this is interpreted to be the origin of the pseudogap [1]. Recently the Förster *et al* [2] succeeded in making monolayer $BaTiO_3$ film on Pt(111) substrate and they revealed that this ultra-thin film has quasiperiodic structure as well as periodic structure. Furthermore, this kind of quasiperiodic structure, could be seen in the interface of periodic structure of other elemental compounds. The electronic states of this quasiperiodic ultra-thin film represented by $BaTiO_3$ is still unclear. In this study, we used $BaTiO_3$ ultra-thin film grown on Pt(111) substrate and 10-symmetry AlNiCo quasicrystal as samples and detailed electronic states of these samples were studied by two-dimensional ARPES

2. Experimental

AlNiCo

To eliminate some contamination of sample surface, 40 hours Ar^+ sputtering (ambient pressure $P_{amb} = 3.0 \times 10^{-3}$Pa, beam energy = 3.0 keV, emission current = 0.5～0.6μA) and annealing at 700K for about 10～15 minutes at 700K.

$BaTiO_3$/Pt(111)

Degass at 600K in keeping UHV and annealing about 5～10 minutes at 900K in O_2 atmosphere($P_{amb} = 5.0 \times 10^{-4}$Pa) to eliminate C contamination. Finally, the sample was annealed at 1000K for about 1～5 minutes.

Photon energy was set to be $h\nu$= 40 eV and measured photoelectron spectra of the valence band using 2D-APRES apparatus DIANA [3].

3. Results and Discussion

AlNiCo

After 40 hours Ar^+ sputtering , we observed peaks derived from Ni and Co in AES. However, after annealing we observed a peak derived from C and could not see spots in LEED pattern. This indicates that sample surface was contaminated by degasses during the annealing. Next time we prepare a polished sample and keep a better condition of UHV.

$BaTiO_3$

After cleaning the sample, we observed faint LEED spots which might have derived from quasicrystal structure. Figure.1 shows UPS spectrum taken by DIANA ($h\nu$ = 40 eV). Sharp fermi edge which is derived from Pt 5*d* is seen at the valence band top. Peaks A and B are mainly hybrid orbitals of Ti3*d* and O2*p* [4]. Figure.2 shows 2D-APRES results of peak tops (A and B). While the intensity becomes stronger at apart from Γ point in pattern A, the intensity is strong at Γ point in pattern B. Therefore, each peak corresponds to the maximum and the minimum energy of the band which expands from Γ point to the edge of Brillouin zone.

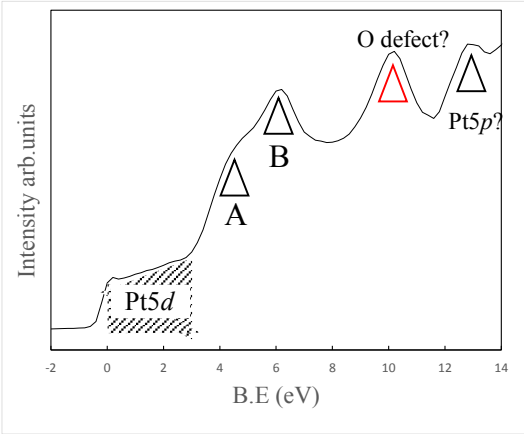

Figure1. UPS results of $BaTiO_3$

4. Conclusion

Since the two-dimensional photoelectron pattern is limited within in a belt in all patterns , DIANA needs some adjustment Furthermore it is necessary to reexamine the cleaning method of the sample.

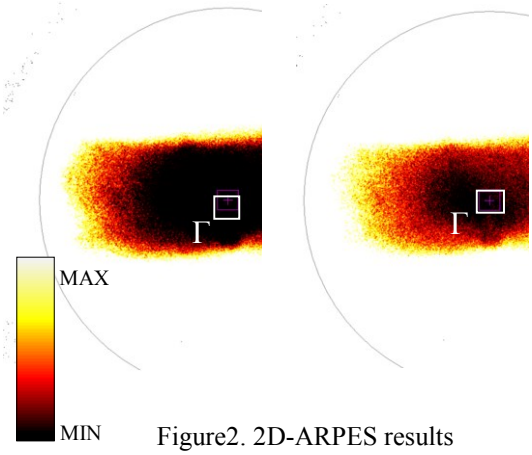

Figure2. 2D-ARPES results

References

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