구두발표 II-4

Order-disorder phase transition in Fe/Pt(110)

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1. Introduction

Order-disorder phase transition in binary alloy has been studied for long time but so far not much microscopic studies on its behavior have been made. One of the classical examples of this phase transition is the Cu_3Au, where the surface and bulk shows somewhat different behavior due to the possible segregation. At the surface, phase separation and disorder are not quite clearly distinguished since most experimental probes are taking the average values in momentum space. For the clear understanding the order-disorder phenomena in atomic scale, we need a local probe such as scanning tunneling microscope(STM). Once the effective pair interaction V which can be defined as the difference in energy after the mixing, is small, then the thermal excitations can compete with this to be in disordered state.

2. Experimental

We have used LEED and STM for the determination of the order parameter and its variation as a function of temperature. All the growth and measurement have been made at UHV condition to avoid the unnecessary contamination. The magnetic phase has been studied with SMOKE. Also the critical temperature for this phase transition can be measured with spot analysis of LEED. For the accurate determination of the energy in ordered and disordered phase, the first principles calculation using the full potential has been applied. For the determination of the pathway of disordering process, we have applied pseudo-potential method.

3. Results and Discussion

The surface of (110) platinum shows missing row structure, which results in (2x1) structure. At room temperature, small amount of Fe overlayers on top of this surface destroys the surface order, while the surface order at low temperature is maintained. This means that the Fe atoms can fill the missing row at low temperature, which results in ordered state of surface alloy. Upon increasing the temperature, this ordered state became disordered. The most remarkable result is that with the atom-resolved STM measurement, we can actually count the entropy of the system, which is important in determining the free energy at this elevated temperature. The importance in magnetic phase in determining the ground state will be discussed. Also the disordering pathway will be shown. Order-disorder phase transition can be treated with the Ising model of the spin system in magnetic filed. The critical temperature obtained with this model is expected to be 115

K, which is quite comparable to our experimental results obtained from LEED intensity analysis.

4. Conclusion

We have actually shown the atomic process of order-disorder phase transition at Fe/Pt(110) system.

5. Reference

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