Fabrication and characterization of surface, interface, and ultra thin films on solid surface

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In the last five years, I have been studying the following topics using variety of techniques such as LEED, AES, STM, ISS, RBS, PES, and ARUPS; (a) two dimensional alloy on metal surfaces, (b) surface structure of an decagonal quasicrystal, (c) oxide surface and metal-oxide thin films on metal surfaces, (d) binary adsorbates on Si(111) surface, (e) characterization of δ-doped Si(111) with RBS channeling. I will review these topics in this seminar.

To fabricate two dimensional (2D) alloy, a substrate has to be static and inert against adsorbates. The two dimensional alloy is a overlayer monolayer film and should be incommensurate to the substrate. Recently, I succeeded in fabricating a Pb-Sn 2D alloy for the first time using a Rh(111) surface [1]. It is also found this year that similar Pb-Sn 2D alloy is formed on a Ru(0001) surface, too. Physical properties of the Pb-Sn 2D alloy are found to be independent to the substrate.

The bulk structure of a quasicrystal has been studied intensively using TEM and TED methods. However, none of these techniques have monolayer depth resolution and it is sensitive to the heavier element, although a major component is usually a light element, like Aluminum. I demonstrated to identify the Al atomic arrangement on a $Al_{72}Co_{16}Ni_{12}$ decagonal quasicrystal surface by means of STM and ISS [2].

Although oxide surface structures are much more complex than metal surfaces, recent advance surface science technology makes it possible to identify such a complex structure, too. Rhodium oxide surface and tin-oxide monolayer films on Rh(111) surface are examined and identified by our recent studies [3,4].

It has been studied for a decade that binary metal adsorbates on Si(111) surface induce a unique superstructure that is different from single metal adsorbate. In the case of lead and tin on Si(111) surface, they form a variety of superstructures, like √7x√3, 6x3, and √3x√3 structures. Both √7x√3 and 6x3 structure are found to be the unique low dimensional surface alloy [5], although lead and tin are immiscible in bulk.

We have a AN-2500 Van de Graaff accelerator for RBS channeling analysis in Nagoya University. I will briefly talk about interface analysis of the Ge δ-doped Si(111) [6], if I have a time.

Reference

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