Development of High Throughput Laboratory HXPS System Using Monochromatic CrKα X-ray Source and Wide Acceptance Objective Lens

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Introduction

Here we introduce the present status of development of a wide acceptance high throughput laboratory HXPS system using monochromatic Cr Kα x-rays.

elements of the system

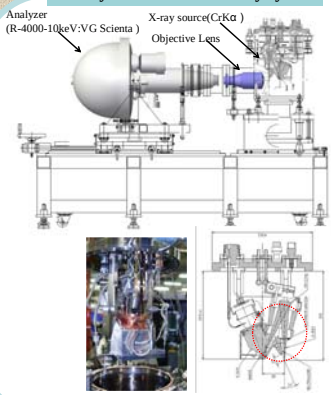
(1) Focused Monochromatic CrKα Source (ULVAC-PHI, Co.)
A water cooled Cr target is excited by a focused electron beam. The emitted X-rays are monochromatized at Cr Kα (5.4 keV), and focused on to a sample surface by a compact bent crystal monochromater with 300 mm Roland circle. The X-ray spot is variable from 10μm (1.25 W) to 200 μm (50 W)

(2) Wide acceptance angle objective lens(NAIST)
H. Matsuda, H. Daimon, M. Kato, and M. Kudo, Phys. Rev. E 71 (2005) 066503.

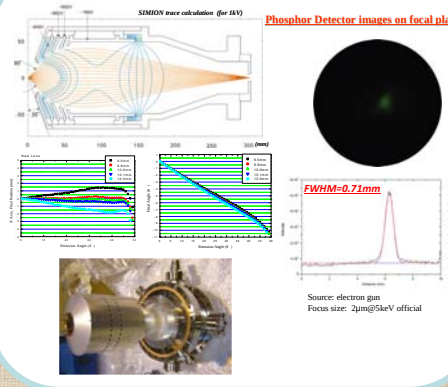
In front of a VG Scienta R4000 10kV analyzer, a wide acceptance angle resolving objective lens is installed to accept photoelectrons emitted within ±45 deg from a sample and output them within ±9 deg at the exit.

(3) High Kinetic Energy Analyzer (VG SCIENTA R4000 10kV)

The layout of the laboratory system



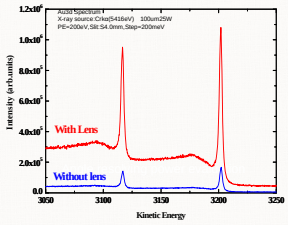
Performance of objective lens



Performance of the Lab system

Effect to the object lens throughput

Au3d Spectrum

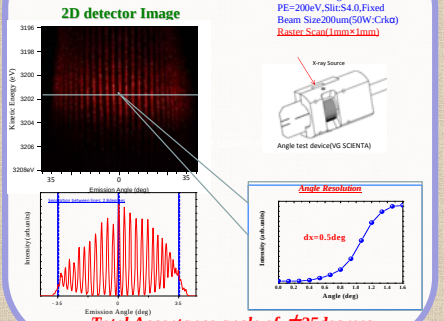


	Au3d5/2		
	without lens	with lens	ratio
Area	6.76E+05	4.91E+06	7.3
Height	1.55E+05	1.03E+06	6.6
Width(eV)	2.77	2.78	

Intensity increased about 7 times

Angle resolving power evaluation

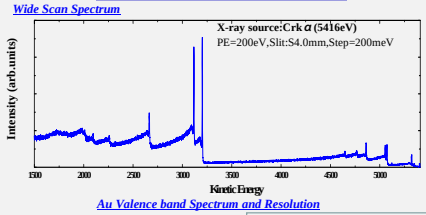
Au3d(3.2keV)



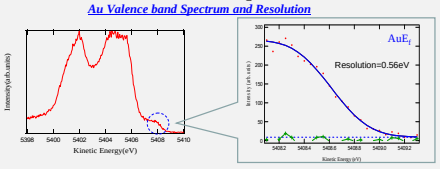
Total Acceptance angle of ±35degrees

Wide Scan and Total Resolution

Wide Scan Spectrum



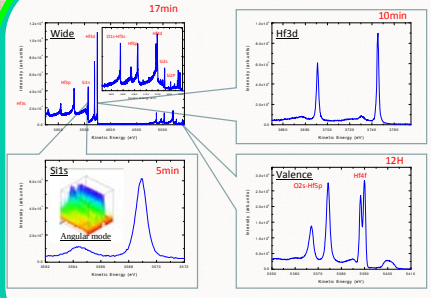
Au Valence band Spectrum and Resolution



Total Resolution =0.56eV

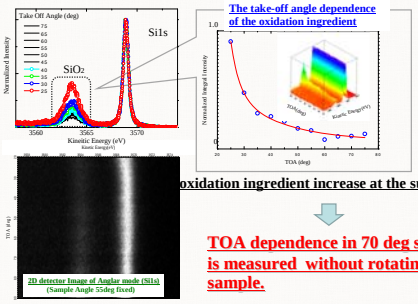
Applications

HfO_2(4nm)/SiO_2(1nm)/Si



layer buried under the 4 nm over layer is observed

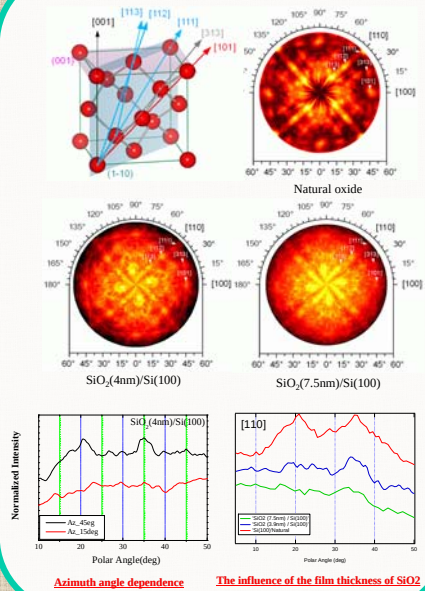
SiO_2(4nm)/Si



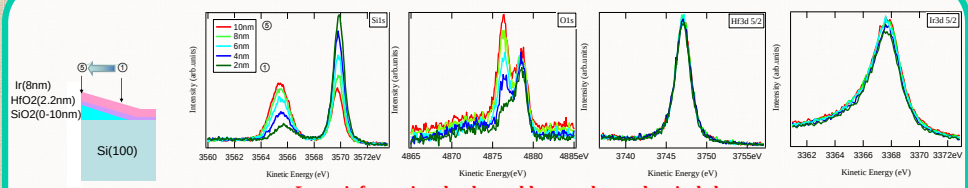
oxidation ingredient increase at the surface !

TOA dependence in 70 deg span is measured without rotating sample.

X-ray Photoelectron Diffraction



Ir(8nm)/HfO_2(2.2nm)/SiO_2 (0-10 nm)/Si (100)



Large information depths enable us to detect chemical changes in the buried layers in a wedge shape sample

summary

The HXPES-system developed enables us to access buried layers with practical thropughput without surface treatment.

The throughput increases of more than 10 times are expected by optimizations of the metal mesh electrode and the configuration of whole system.

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