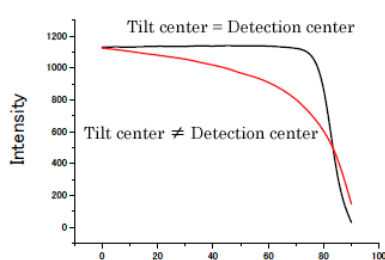


## Analysis of Surface Nano Structure in Angle Resolved Auger-XPS High sensitivity surface analysis using ARXPS

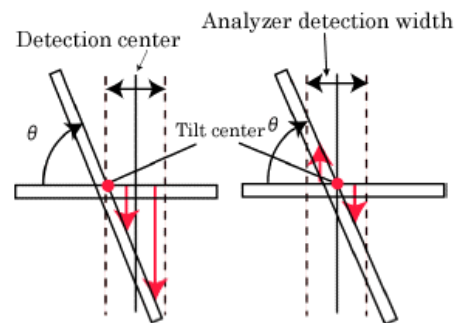
### What is ARXPS?

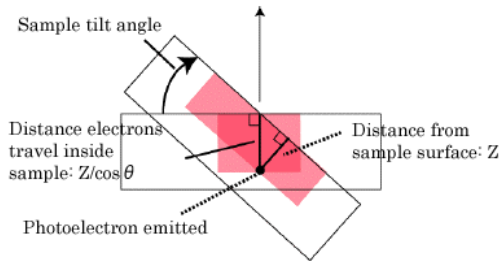
Angle resolved X-ray photoelectron spectroscopy (ARXPS) is a technique to control the detection depth of a sample by changing the sample tilt angle with reference to the analyzer. Unlike depth profiling with ion sputtering, ARXPS is capable of non destructive analysis of areas deep down to the escape depth of photoelectrons. Data acquired in ARXPS determine the following:

- Relative positions of materials present within the escape depth of photoelectrons
- Thickness of surface layering

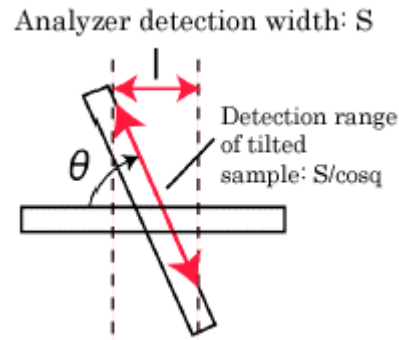


When the detection center differs from the tilt center, the sample height will change in one direction relative to the tilt, and so will the peak intensity. When the detection center coincides with the tilt center, the sample height will change in both directions, offsetting the changes in peak intensity.





The detection depth is proportional to  $\cos\theta$ .

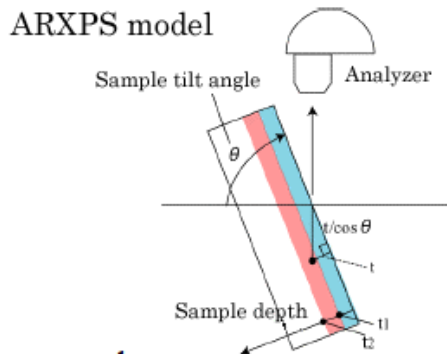


The detection area is proportional to  $1/\cos\theta$ .

The peak intensity detected is expressed as:  $\cos\theta$  (change in detection depth)  $\times$   $1/\cos\theta$  (change in detection area) = const

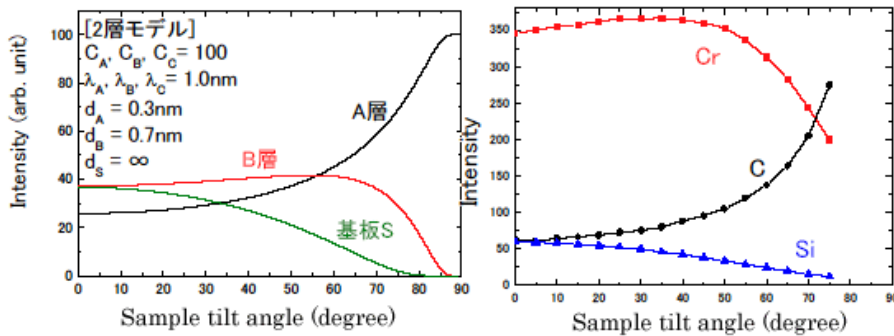
In analyzing a bulk sample, if the intensity is constant when the tilt center agrees with the detection center, the resulting data will reflect the in-depth structure of the sample.

### ARXPS model

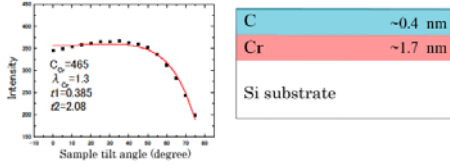


$$I_A(\theta) = \frac{1}{\cos\theta} \cdot \int_{t_1}^{t_2} \Delta I dt = C_A \cdot \lambda_A \cdot \left\{ \exp\left(\frac{-1}{\lambda_A} \cdot \frac{t_1}{\cos\theta}\right) - \exp\left(\frac{-1}{\lambda_A} \cdot \frac{t_2}{\cos\theta}\right) \right\}$$

$C_A$ : Concentration distributions in  $t_1$  and  $t_2$  layers  
 $\lambda_A$ : Mean free path of electrons emitted from 2<sup>nd</sup> layer



The resulting profile and the curve from model calculation were compared to estimate the thickness of the layer structure. The figure on the left shows the calculated intensity of each layer, while the figure on the right shows the measured results.



The film thicknesses above were obtained by applying the least square fitting technique to the calculated and measured data.

### Results of least square fitting