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Angle Variable XPS Analysis Applied to Organic Materials

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X–ray Photoelectron Spectroscopy(XPS, ESCA) is useful technique for surface analysis of solid organic materials. Analyzed depth is changeable using variant detection angle within escape depth. If overlayer exists, photoelectron intensity ratio between that of overlayer and base material varied with detection angle. We apply this principle and peak shape analysis for measuring thickness of surface oxide layer in metallic or semiconducting materials. But it is difficult that analysis of organic overlayer on organic base material for pointing out following explanation.

1. Substratum and overlayer are composed of same elements.
2. It is similar to photoelectron peak shape or binding energy value in both layers.

It is difficult to resolve photoelectron peak into component of each layer. Instead of applying peak shape analysis, we utilize only photoelectron intensity ratio between that of overlayer and substratum varied with detection angle. In each detection angle, it substitute measured photoelectron intensity and some physical constants for theoretical formula of photoelectron emission in the case of overlayer(Equation–1). And the style of Equation–1 is transformed absolute intensity to concentration.

Equation–1

overlayer: $I(Z)/s(Z)=n(Z)C\{1-\exp(-t/d\cos A)\}$

substratum: $I(Z)/s(Z)=n(Z)C\exp(-t/d\cos A)$

I(Z):Phototelegram intensity of element Z
s(Z): excitingly cross section of element Z
n(Z):atomic concentration element Z
A:Detection angle measured from surface normal
t:Overlaying thickness
d:Escape depth of photoelectron
C:Constant

Simultaneous equations that overlayer thickness and concentration are variable is solved. Finally, rough overlayer thickness and composition is able to estimate simultaneously. A merit of this analysis procedure is pointing out the following matter.

1. For analyzing not peak shape but photoelectron intensity, high energy resolution measurement is needless.
2. It can find concentration and overlayer thickness at the same time.

A demerit of this analysis method is showing the following explanation.

1. It assume two layers structure having flat overlayer that composition and thickness is uniform.
2. It is desirable that substratum composition is known.

We are planning to introduce some application of this method.

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