Polarization Dependent Fluorescence X-ray Absorption Fine structure Studies on the Metal species at the interface of Organic Molecule.

– Its Possibility to the Application of Biointerface

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X-ray absorption fine structure is a powerful technique to investigate the local structure around X-ray absorbing atom. However, when it is applied to a biointerface created on a substrate surface, it will be difficult due to the small concentration of the X-ray absorbing atoms. We have developed a new technique to determine the three-dimensional structures of the surface metal species dispersed on the flat substrate with low concentration( $1 \times 10^{13}$ atoms / cm²).[1] The technique is called as polarization dependent total reflection fluorescence XAFS(PTRF-XAFS). In this paper we describe some examples about metal species dispersed on the TiO₂ (110) single crystal and organic compounds modified TiO₂(110) surfaces. We will discuss the possibilities of its application to biointerface problems.

Cu and Au on TiO₂(110)

TiO₂ is one of the typical support materials for catalysts on which metal is dispersed as a nanocluster but its structure, interaction with surface and formation mechanism are not yet clear. TiO₂ (110) surface has an anisotropic structure with both exposed Ti and oxygen running along the [001] direction shown in Fig. 1. When the Cu and Au were deposited on the surface, they aggregate to give 3 dimensional nanoclusters. This indicates the weak interaction between Cu (Au) and the TiO₂(110) surface and it was quite difficult to obtain atomically dispersed Cu (Au) species on this surface.[2]

Cu and Au on the modified TiO₂(110) surface

A strategy to have an atomically dispersed Cu(Au) is to increase the interaction of TiO₂(110) surface with Cu(Au). S atom has a larger interaction with Cu and Au. A carboxylic acid is adsorbed strongly on the TiO₂(110) surface. Thus we use a molecule with two moieties S and COOH. We put thiophene carboxylic acid(TCA) on top of the TiO₂(110) surface and obtained atomically dispersed Cu species [3] and flat 2 layer Au clusters. The different structures were due
to the different interaction of S with Cu and Au. The o-mercaptobenzoic acid(o-MBA) was adsorbed on the surface, we could make the Au atomically dispersed.[4]

**Application of PTRF-XAFS to biointerface.**

One demerit of PTRF-XAFS is the presence of liquid phase which created strong scattering and deteriorated the S/B ratio. We are constructing a new highly sensitive method to which enables us to carry out the lower concentration with the presence of solution. We will discuss the possibility of the bioapplications of the PTRF-XAFS.

![Fig.1 The TiO\(_2\)(110) surface. Large ball and small ball indicates the oxygen and Ti](image)

**References**


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**Education**

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