13A/2012G093

Photoelectron spectroscopic study of CO adsorption on Pd(100) single crystal surface under ambient-pressure conditions

Ryo TOYOSHIMA[1*], Masaaki YOSHIDA[1], Yuji MONYA[1], Kazuma, SUZUKI[1], Kenta AMEMIYA[2], Kazuhiko MASE[2], and Hiroshi KONDOH[1]

[1]Keio University, Hiyoshi, Kanagawa 222-8522, Japan

[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

INTRODUCTION

The adsorption structure of carbon monooxide (CO) on late-transition metal surfaces under atmospheric conditions is an issue of technological and scientific interest. In this study, we conducted a work on CO adsorption on a Pd(100) single crystal, because the Pd has been used as a catalyst of CO oxidation (i.e. three-way catalyst). Under UHV conditions, the adsorption structure has been widely investigated.[1-2] Ambient-Pressure X-ray Photoelectron Spectroscopy (AP-XPS) enables to measure the XP spectrum even under 1 Torr pressure condition using a differential pumping system.

EXPERIMENTAL SECTION

A Pd(100) single crystal was cleaned using well-established procedures in a preparation chamber, the base pressure was < 2×10^{-10} Torr. Then it was transferred to a high-pressure experimental chamber. The CO gas (99.99% purity) was introduced to the chamber up to 0.5 Torr at room temperature. The photon energy of 435 eV was used for $Pd3d_{5/2}$ and C1s XPS.

RESULTS and DISCUSSION

Fig. 1 shows a series of $Pd3d_{5/2}$ XP spectrum of CO adsorption up to 0.5 Torr. At 1×10^{-7} Torr, the bulk and an additional peak component at higher binding energy CO(I) are observed. This is associated with the $(2\sqrt{2}\times\sqrt{2})R45°$ structure. With increasing CO gas pressure, a new component CO(II) appears at about 336 eV, and the $(3\sqrt{2}\times\sqrt{2})R45°$, (II)/(I)=0.5 and $(4\sqrt{2}\times\sqrt{2})R45°$, (II)/(I)=1 is formed. These structures have been found at low temperatures under UHV conditions.

However, a new structure, (II)/(I)>1, is reversibly observed at 0.5 Torr. This is interpreted as a (1×1) structure predicted by theoretical calculations.[3]

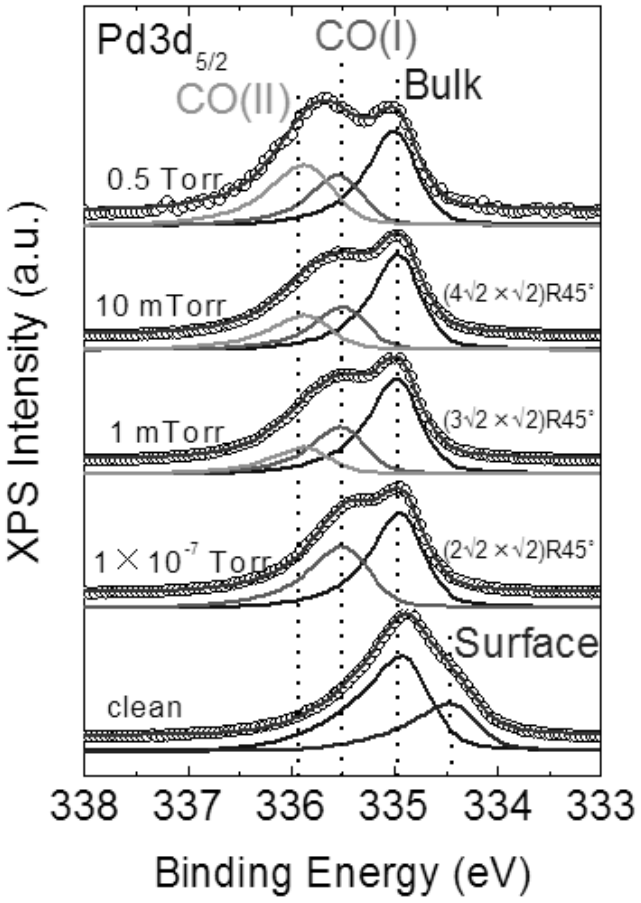

Figure1 a series of $Pd3d_{5/2}$ XP spectrum up to 0.5 Torr CO pressure at room temperature.

References

1. Berndt et al., *Surf. Sci. Lett.* **1988,** *279*, L165.
2 .Andersen et al., *Phys. Rev. Lett.* **1991,** *67*, 2822.
3. Rogal et al., *Phys. Rev. Lett.* **2007,** *98*, 046101.