

Phase tomography with X-Ray Talbot Interferometer

Atsushi MOMOSE (4353)*^a, Shinya KAWAMOTO (8334)^b,
Ichiro KOYAMA (1715)^a, Akiko FUJII (9856)^b, Yoshio SUZUKI (1177)^c

^aDepartment of Advanced Materials Science, Graduate School of Frontier Sciences, The University of Tokyo

^bDepartment of Applied Physics, School of Engineering, The University of Tokyo
^cJASRI

Talbot interferometry using two transmission gratings is feasible as a novel and simple method for phase-sensitive X-ray imaging as demonstrated in the previous experiments [1,2]. In this report we demonstrate that phase tomography is also attainable with X-ray Talbot interferometry.

The experimental setup is shown in Fig. 1. Gold transmission gratings with an 8-micron pitch were aligned with a separation of 32 cm along the optical axis. A sample was placed in front of G1, and images were acquired with a CCD-based image detector whose effective pixel size was 6.33 μm. The measurement of a differential phase map by using the technique of phase-shifting interferometry was performed, displacing the second grating (G2) against the first grating (G1) in the direction shown in Fig. 1 with a step of one fifth of the period of G2. A phase map was calculated by integrating the differential phase map. This phase measurement was repeated at 250 angular positions of sample rotation over 180°.

Figure 2 shows an image obtained by phase tomography for a plastic sphere 1.2 mm in diameter. By analyzing this tomogram, the detection limit of the refractive index was 5×10^{-9} (standard deviation), which corresponded to the density deviation of 4 mg/cm³. A sectional image obtained for a head of an ant is shown in Fig. 3. A structure inside the head was successfully revealed, and thus phase tomography for a biological sample was feasible.

[1] A. Momose *et al.*, *Jpn. J. Appl. Phys.* **42** (2003) L866.

[2] A. Momose *et al.*, in *SRI2003 proceedings*.

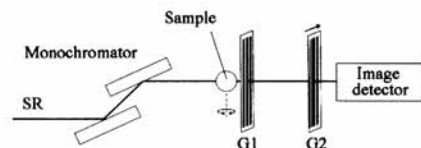


Fig. 1. Experimental setup of phase tomography with X-ray Talbot interferometer.

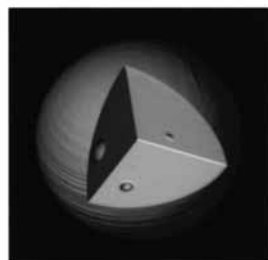


Fig. 2 A rendering view of the tomographic data obtained for a plastic sphere 1.2 mm in diameter.

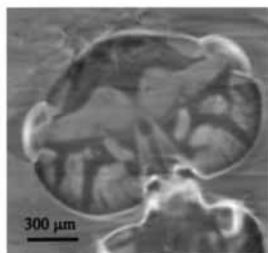


Fig. 3 A sectional image obtained for a head of an ant.

Photoemission study of oxidation process induced by hyperthermal O₂ molecular beam on Au(111) nano-surface

Michio OKADA (7451)^(a), Seishiro GOTO (2522)^(a), Kousuke MORITANI (7459)^(b), Akitaka YOSHIGOE (1305)^(b), Yuden TERAOKA (390)^(b), and Toshio KASAI (5593)*^(a)

(a) Department of Chemistry, Graduate School of Science, Osaka University, 1-1 Machikaneyama-cho, Toyonaka, Osaka 560-0043, Japan

(b) Synchrotron Radiation Research Center, Japan Atomic Energy Research Institute, 1-1-1 Kouto, Mikazuki-cho, Sayo-gun, Hyogo 679-5148, Japan

Dioxygen (O₂) dissociation on transition metal surfaces is of considerable research and practical interest both because many important industrial oxidation processes are heterogeneously catalyzed by transition metals and feature of O₂ as the oxidizing agent and because O₂ dissociation is the first step toward the corrosion of various metals. In the present experiments, we have elucidated oxidation processes of Au surface using O₂ molecular beams with hyperthermal energy of 2.3 eV.

All experiments were performed at the surface reaction analysis apparatus at BL23SU. An Au (111) sample was cleaned by the repetition of sputtering with Ar⁺-ion beams and annealing at 1073 K, until no impurities could be detected by X-ray photoelectron spectroscopy (XPS) and Low-energy electron diffraction (LEED) showed a sharp ($23 \times \sqrt{3}$) pattern with low background. The O-1s photoemission peak was measured using monochromatic synchrotron radiation after the exposure of the Au(111) surface to a proper amount of hyperthermal O₂ molecular beams.

We measured the O-1s peak with XPS for the incidence of 2.3-eV-O₂ molecular beam on the Au(111) surface. Even with increase of O₂ dose, we could not find any features of adsorbed O atoms on the Au (111) surface in the XPS spectra. Thus, it is very difficult to

oxidize the Au(111) surface even using hyperthermal O₂ molecular beams. The incident energy of 2.3 eV is enough for an O₂ molecule to overcome the activation barrier of ~1.8 eV [1]. However, for the dissociative adsorption of O₂ molecule, the dynamical limitation due to a short collision time at a high incident energy may be so important that the oxidation of Au can't be induced.

We also tried the oxidation by O atoms produced with a hot W filament. However, volatile tungsten oxide produced at the hot W filament is deposited on Au. So, it was very hard to evaluate the reactivity of Au with O atoms. Finally, we used the 1-keV-O₂⁺ ion beams for oxidation of Au. We could oxidize the Au surface as shown in Fig. 1, although the saturation coverage was rather smaller compared to the Cu oxidation case.

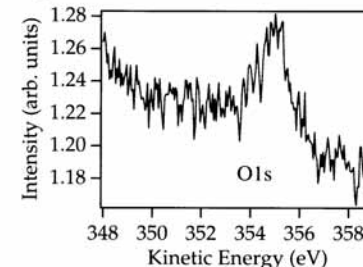


Fig.1. O1s XPS spectrum for O/Au(111)

[1] N.Saliba *et al.* *Surf. Sci.* **410** (1998) 270.