Oxidation Reaction Dynamics on Ti Surfaces Using Translational Energy Controlled Oxygen

Y. Takakuwa[a]* (7328), S. Ogawa[a] (13303), S. Ishidzuka[b] (7449), K. Moritani[c] (7459), A. Yoshigoe[c] (1305) and Y. Teraoka[c] (390)

[a]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University
[b]Material Engineering Department, Akita National College of Technology
[c]Synchrotron Radiation Research Center, Japan Atomic Energy Research Institute

In order to clarify the reaction dynamics of O_2 molecule on Ti surfaces, the oxygen uptake and oxidation state during oxidation on the Ti(0001)-1×1 surface at room temperature using an translational kinetic energy E_t controlled O_2 molecular beam were monitored in real time by O 1s photoelectron spectroscopy with a fast sampling time of 10 s and a high total energy resolution of 1.0 eV for the chemically shifted components.

Figure 1 shows the oxygen uptake curve obtained by integrating O 1s spectra, that is, including all chemically shifted components. At E_t=0.03 eV, the oxygen uptake proceeds very rapidly at the initial stage and then slows down its increase rate. When the E_t is increased to 0.55 eV, the initial rate of oxygen uptake decreases considerably. However, it recovers slightly at 1.50 eV, compared with that at 0.55 eV.

By differentiating the uptake curve, we estimated the initial sticking probability S_0 at O_2 dosage = 0 L. In Fig. 2, the dependence of S_0 on E_t is depicted. As the E_t increases from 0.03 eV, the S_0 decreases rapidly to about an eighth at 0.55 eV and then increases. After showing a maximum at 0.85 eV, it decreases very gradually. Thus the S_0 has a minimum at 0.55 eV and a maximum at 0.85 eV, while it decreases in the whole trend with increase of E_t. This clearly indicates that O_2 molecules dissociate through the physisorbed state with an energy barrier (larger than E_t = 0 eV) to the chemisorbed state, which is referred as a trapping-mediated adsorption model.

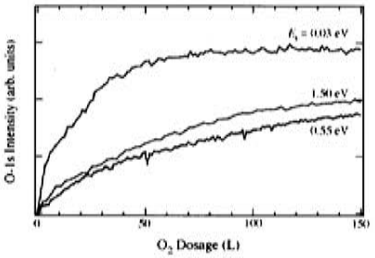

Fig. 1. O_2 dose dependence of O-1s photoelectron intensity during oxidation on the Ti(0001) surface at room temperature (27℃) using an O_2 beam with translational kinetic energies of 0.03, 0.55 and 1.50 eV. The photon energy was 662 eV under the surface sensitive condition.

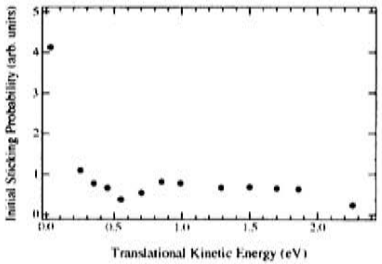

Fig. 2. Translational kinetic energy dependence of the initial sticking probability for O_2 molecules on Ti(0001)-1×1 surface at room temperature.

Soft X-ray Magnetic Circular Dichroism Study of CoNiFe Alloy Soft Magnetic Films with a Stripe Magnetic Domain Structure Used for Ultra High Magnetic Recording Materials.

***Toru Asahi[a](8225), Tetsuya Osaka[a](8969), Jun Kawaji[a](8937), Jun-ichi Sayama[a](8885), Masahito Tanaka[a](5537), Naomichi Nakamura[a](14931), Akane Agui[b](1709), Masaichiro Mizumaki[c](1171)**

[a]Graduate School of Science & Engineering, Waseda Univ., [b]JAERI, [c]JASRI.

Soft magnetic films play an important role for double-layered perpendicular magnetic recording media. We examined the expectation values of orbital angular momentum <*Lz*> and spin angular momentum <*Sz*> of electrolessly deposited CoNiFeB soft magnetic film by soft X-ray magnetic circular dichroism (MCD) measurement at SPring-8 BL23SU. Moreover, the effect of the external magnetic field applied to samples during electroless deposition on their values was investigated.

Fig. 1 shows typical data of observed MCD and X-ray absorption spectra (XAS). Using the sum rule, we obtained <*Lz*> and <*Sz*> values of Co and Ni atoms. In the case of Fe, <*Lz*>/<*Sz*> values only were obtained because XAS peaks of Fe oxides were not removed from the measured peak. Obtained values are summarized in Table 1.

From these vales, we concluded that the *3d* orbital magnetic momentums of Co and Ni atoms of the samples prepared with the magnetic field applied during electroless deposition are higher than those of the samples prepared without it, but that the *3d* spin magnetic momentums of Co and Ni atoms of their samples were almost the same.

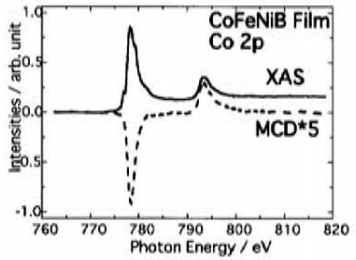

Fig.1 Examples of XAS (solid line) and MCD (dotted line) spectra of CoNiFeB film prepared without additional magnetic field.

Table 1. Values of <*Lz*>, <*Sz*> and <*Lz*>/<*Sz*> obtained with XAS and MCD spectra, where ON and OFF indicated in *H* column mean whether the films was prepared with magnetic field applied during deposition or not, respectively. Noted that hole numbers of each atom are not considered.

Atom	*H*	<*Lz*>	<*Sz*>	<*Lz*>/<*Sz*>
Co	ON	0.080	0.205	0.388
	OFF	0.053	0.199	0.268
Ni	ON	0.092	0.198	0.466
	OFF	0.069	0.201	0.340
Fe	ON	-	-	0.130
	OFF	-	-	0.194