Materials Science

NW10A/2007G626

Fluorescence EXAFS measurements of Trigonal Tellurium

Yasuhiro OKUDA[1], Hitoshi MAEKAWA[1], Hiroyuki IKEMOTO[1], Takafumi MIYANAGA[2], Kiyofumi NITTA[3]
[1] Univ. of Toyama, Toyama 930-8555, Japan
[2] Hirosaki Univ., Hirosaki 036-8561, Japan
[3] KEK-PF, Ibaragi 305-0801, Japan

Introduction

Trigonal tellurium (t-Te) has a hierarchy structure, that is, tellurium atoms are bonded together to form chains and the chains are in turn bound together into a hexagonal lattice. It is expected that Te nanoparticles have exotic structure originated from the hierarchy structure. Our results of X-ray diffraction suggest that the Te nanoparticles are amorphous, so it is important to do in situ sample preparations and experiments of the Te nanoparticles at low temperatures. We plan to do in situ sample preparation and the extended x-ray absorption fine structure (EXAFS) experiments at liquid nitrogen temperature. We have to establish the method of fluorescence EXAFS measurements at low temperatures. In this report the fluorescence EXAFS measurements at low temperatures are reported.

Experimental

Tellurium was deposited on the slide glass and the thickness is 300 nm. Glancing angle fluorescence EXAFS for Te K-edge (31.8 keV) was measured with our sample holder at 25, 100 and 300K at the NW10A of PF-AR. The sampling energies and dwell time are same with those of the transmission EXAFS in order to compare data quality of the fluorescence EXAFS with that of the transmission EXAFS.

Results and Discussion

The sample having the film thickness of 300 nm is trigonal form as shown by X-ray diffraction experiments. Figure 1 shows the EXAFS functions for the transmission and the fluorescence measurements at 25 K. The quality of the fluorescence measurement is comparable with that of the transmission measurement, especially below 9 A^{-1}. If the dwell time of high wave number region are increased, the quality of the EXAFS functions would be improved.

Figure 2 shows the Fourier transform of the EXAFS functions shown in Fig. 1. In t-Te the first, second and third intrachain atomic distances are 2.835, 4.45 and 4.89 A, and those of the interchain are 3.495 and 4.46 A, respectively[1]. Every peak originated from the intra- and interchain correlations is clearly observed. The peak intensities of the fluorescence EXAFS are smaller than those of the transmittance EXAFS.

Preliminary results of the least-squared fitting analysis of the first and second peaks in the Fourier transform are shown in Table 1. FEFF 8.2 was used to calculate theoretical values[2]. The coordination numbers are not scaled by the scaling factor. The values of the intra and interatomic distances from the fluorescence measurements are in agreement with those of the transmission measurements within experimental errors. In contrast, we obtained poor results about the coordination naubers. It is essential that the good quality of the fluorescence EXAFS signals in the high wave number region are obtained to discuss the coordination number.

References

[1] C.Adenis, V.Langer, O.Lindqvist, Acta Cryst. (1989). C45, 941-942
[2] E.Sevillano, H.Meuth, J.J.Rehr, Phys.Rev.B20.4908 (1979)
**ikemoto@sci.u-toyama.ac.jp

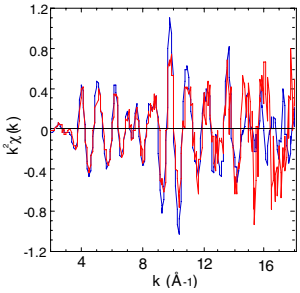

Fig. 1 EXAFS functions of t-Te at 25K. Blue line: transmission measurement; red line: fluorescence measurement.

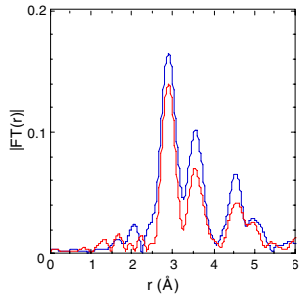

Fig. 2 Fourier transforms of EXAFS functions shown in Fig. 1.

Table 1 First nearest intrachain interatomic distance r_1 and coordination number N_1, and first nearest intrachain interatomic distance r_2 and coordination number N_2.

	Intrachain		Interchain	
	r_1	N_1	r_2	N_2
XRD[1]	2.835	2.0	3.495	4.0
Transmission	2.839	2.8	3.473	5.7
Fluorescence	2.821	1.5	3.461	4.6