

**X- (XRD) UO<sub>2</sub>**

**The measurement of micro area for UO<sub>2</sub> fuel  
by the conventional X-ray diffractometer**

150

X optics(X- concentrator) XRD , UO<sub>2</sub>  
 . X- (0.02 X 4 mm) 6,000 counts/sec.  
 . UO<sub>2</sub> (X-ray tube: CuK , 40kV, 40mA;  
 aperture slit: 0.02mm; detector slit: 1/Ni/0.6mm; detector: scintillation counter; measuring  
 time/step: 40 sec/0.02°) UO<sub>2</sub> 17 counts/sec. .

**Abstract**

The measurement of micro area for UO<sub>2</sub> fuel using the conventional X-ray diffractometer (XRD) without beam concentrator was investigated. The maximum x-ray intensity with micro slit (0.02 X 4 mm) was 6,000 counts/sec. The peak intensity of UO<sub>2</sub> was below than 17 counts/sec. at the optimum condition to increase the intensity (X-ray tube: CuK , 40kV, 40mA; aperture slit: 0.02mm; detector slit: 1/Ni/0.6mm; detector: scintillation counter; measuring time/step: 40 sec/0.02°)

1.

가 UO<sub>2</sub> 가 . , 가

-damage, fission damage, - - UO<sub>2</sub> , thermal healing  
 effect, local burn up rim structure formation, rim Xe-depletion .  
 (UO<sub>2</sub> ) .[1]

X-ray diffractometer (XRD) ,  
 Rim μm . XRD  
 30 - 50 μm . X-ray

beam 10 - 20 μm가 .  
 X- capillary [2]  
 [3]. Capillary

UO<sub>2</sub> X- 10 - 50  
 capillary 가  
 PIE

, XRD .

## 2.

### 2.1 UO<sub>2</sub>

UO<sub>2</sub> ( 8.3 mm) .

### 2.2 Micro slit

BRUKER 0.02 mm slit .

### 2.3

#### 2.3.1 X-

0.02 mm slit width X- , X-

(2θ: -1° ~ 1°) . XRD BRUKER D5000 ,

divergence slit: 0.02 X 4 mm, detector slit: 1/Ni/0.05 mm, X- : CuK (40 kV, 40 mA),  
 measuring time/step: 1 sec. / 0.02° .

#### 2.3.2 UO<sub>2</sub>

0.02 mm slit width UO<sub>2</sub> XRD

detector slit: 1/Ni/0.6 mm, CuK (40 kV, 40 mA), measuring time/step: 40 sec. / 0.02 °  
 $2\theta$  25° - 50° UO<sub>2</sub> X- diffractogram .

3.

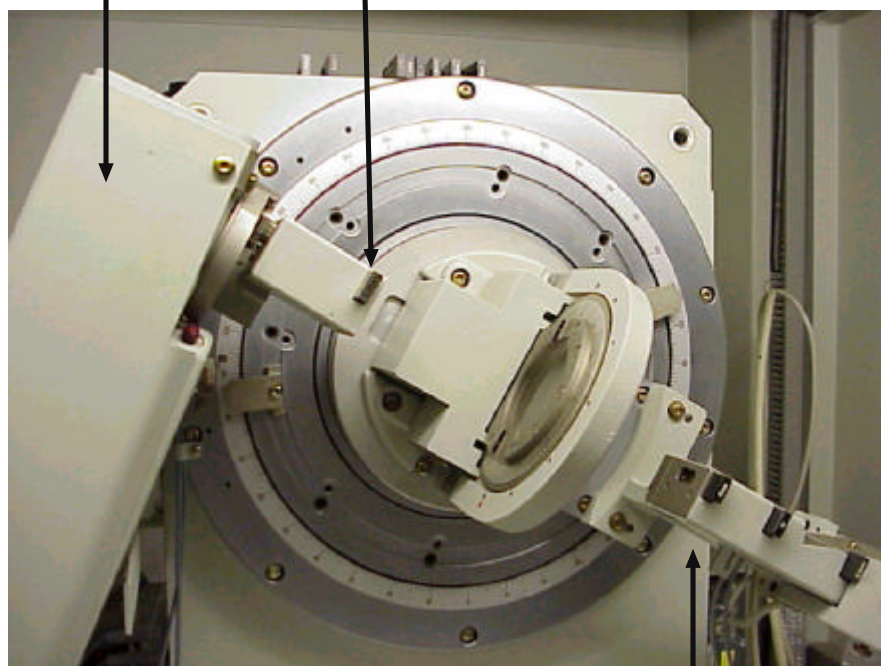
Micro slit(0.02 X 4 mm) X-  
 (Fig. 1). X- . Fig. 2  
 slit X- slit 0.2 mm  
 X- 6,000 counts/sec. 0.02 mm slit  
 X- 0.2 mm , 가 6,000  
 counts/sec.  
 Fig. 3 X- 가 0.02 X 4 mm UO<sub>2</sub> XRD . UO<sub>2</sub>  
 가 , slit 0.6 mm , 40  
 가 (2 $\theta$  : 25° - 50°) , 14 UO<sub>2</sub> XRD  
 (2 $\theta$  : 25° - 90°) 37 . UO<sub>2</sub> (2 = 28.3°)  
 가 17 counts/sec.  
 가 ,  
 , UO<sub>2</sub> X- 10 - 50  
 , slit . , X-  
 optics가 .

4.

XRD UO<sub>2</sub> micro slit(0.02 mm width)  
 . X- (0.02 X 4 mm) 6,000 counts/sec.  
 . 0.02 mm width slit UO<sub>2</sub>  
 (X-ray tube: CuK , 40kV, 40mA; detector slit: 1/Ni/0.6mm; detector: scintillation counter;  
 measuring time/step: 40 sec/0.02 ° ) 17 counts/sec. .  
 , 10 - 50 X 가 -  
 Micro beam concentrator .

1. J. Spino, D. Papaioannou, "Lattice parameter changes associated with the rim-structure formation in high burn-up  $\text{UO}_2$  fuels by micro X-ray diffraction", *J. Nuclear Materials*, 281, 146-172 (2000).
2. I.C. Noyan, P.C. Wang, S.K. Kaldor, J.L. Jordan-Sweet and E.G. Linger, "Divergence effects in monochromatic X-ray micro diffraction using tapered capillary optics", *Rev. Sci. Instrum.* 71, 5, 1991 (2000).
3. Dimitrios Papaioannou and Jose Spino "A microbeam collimator for high resolution x-ray diffraction investigations with conventional diffractometers", *Rev. Sci. Instrum.* 73, 7, 2659 (2002).

X-ray source      conventional slit (0.02 X 4 mm)



detector

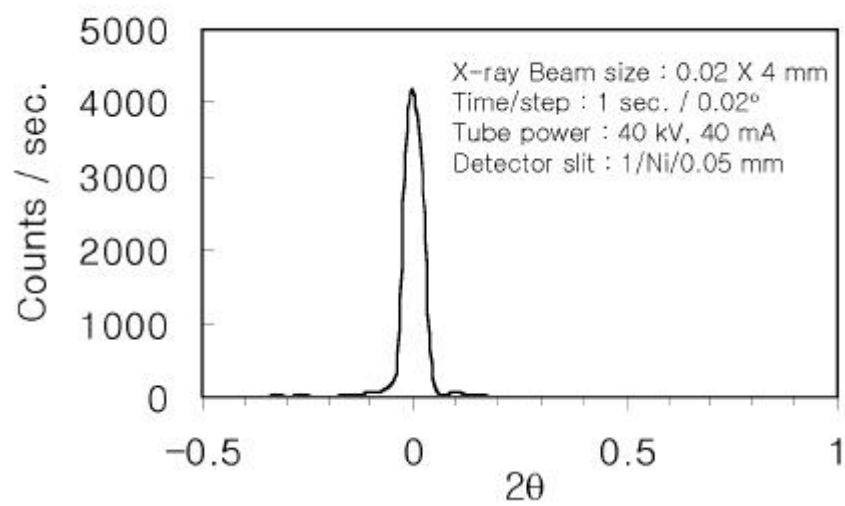


Fig. 1. Intensity profile of micro X-ray beam through a slit by conventional XRD

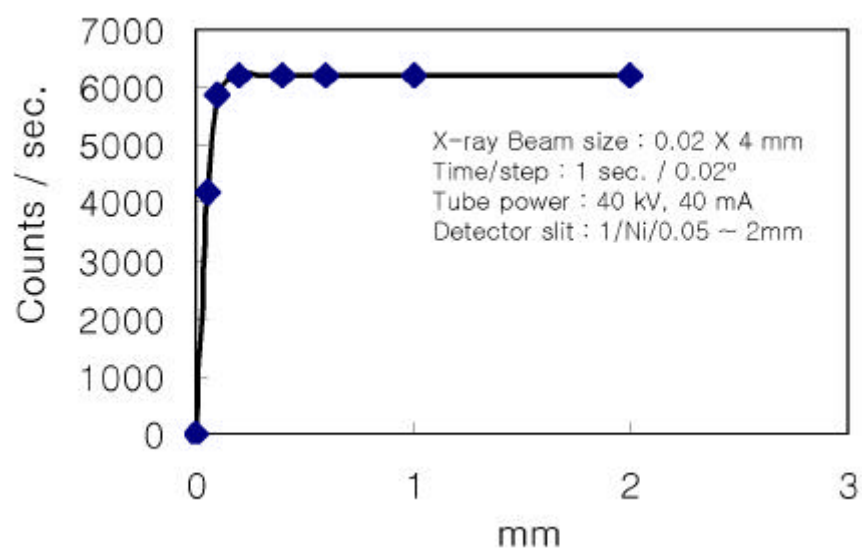


Fig. 2. Determination of the transmitted intensity of micro X-ray beam on detection slit

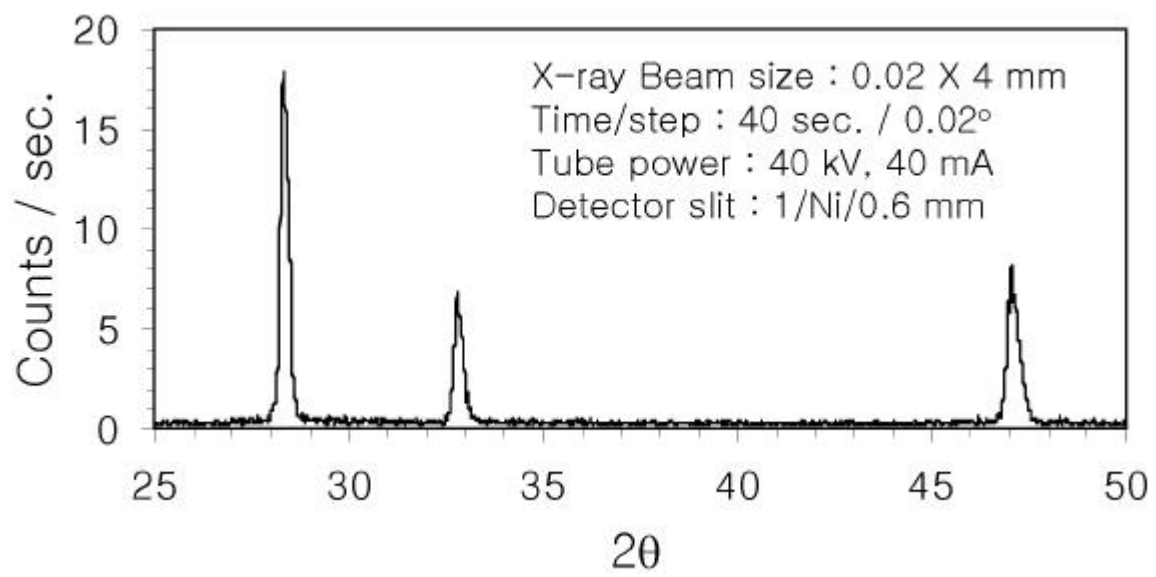


Fig. 3. Diffractogram of UO<sub>2</sub> pellet by conventional XRD with micro X-ray beam