

X- (XRD) UO₂

**The measurement of micro area for UO₂ fuel
by the conventional X-ray diffractometer**

150

X optics(X- concentrator) XRD , UO₂
. X- (0.02 X 4 mm) 6,000 counts/sec.
. UO₂ (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°) UO₂ 17 counts/sec.

Abstract

The measurement of micro area for UO₂ 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 UO₂ 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 UO₂ 가 . , 가

-damage, fission damage, - - UO₂ , thermal healing
 effect, local burn up rim structure formation, rim Xe-depletion .
 (UO₂) .[1]

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

beam 10 - 20 μm가 .
 X- capillary [2]

[3]. Capillary

UO₂ X- 10 - 50
 capillary 가

PIE

XRD

2.

2.1 UO₂

UO₂ (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 UO₂

0.02 mm slit width UO₂ XRD

detector slit: 1/Ni/0.6 mm, CuK (40 kV, 40 mA), measuring time/step: 40 sec. / 0.02 °
 2θ 25° - 50° UO₂ X- diffractogram .

3.

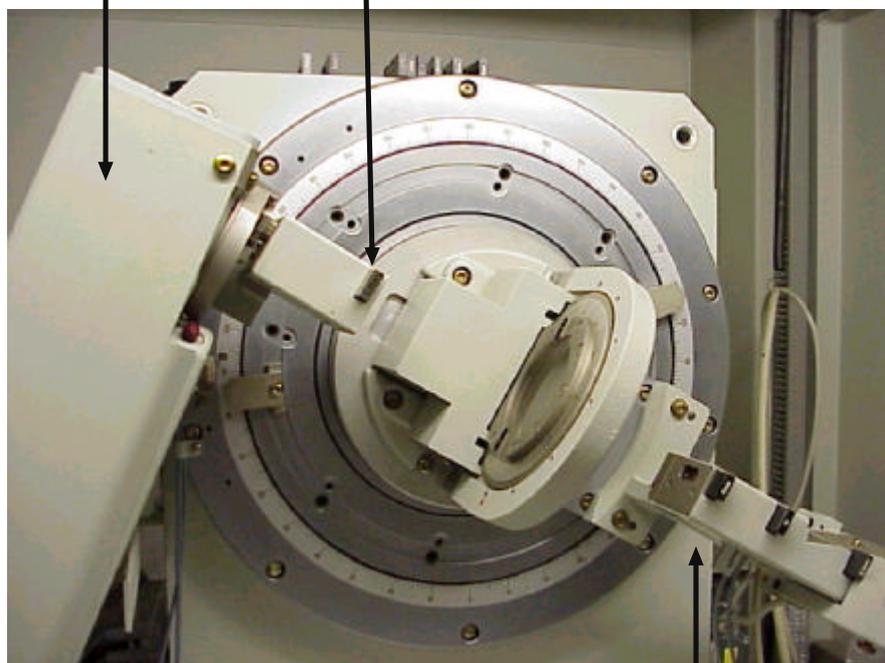
Micro slit(0.02 X 4 mm) X-
 (Fig. 1). X- . Fig. 2
 slit X- slit 0.2 mm
 X- 6,000 counts/sec. 0.02 mm slit
 X- 0.2 mm , 가 6,000
 counts/sec.
 Fig. 3 X- 가 0.02 X 4 mm UO₂ XRD . UO₂
 가 , slit 0.6 mm , 40
 가 (2 θ : 25° - 50°) , 14 UO₂ XRD
 (2 θ : 25° - 90°) 37 . UO₂ (2 = 28.3°)
 가 17 counts/sec.
 가 ,
 , UO₂ X- 10 - 50
 , slit . , X-
 optics가 .

4.

XRD UO₂ micro slit(0.02 mm width)
 . X- (0.02 X 4 mm) 6,000 counts/sec.
 . 0.02 mm width slit UO₂
 (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 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

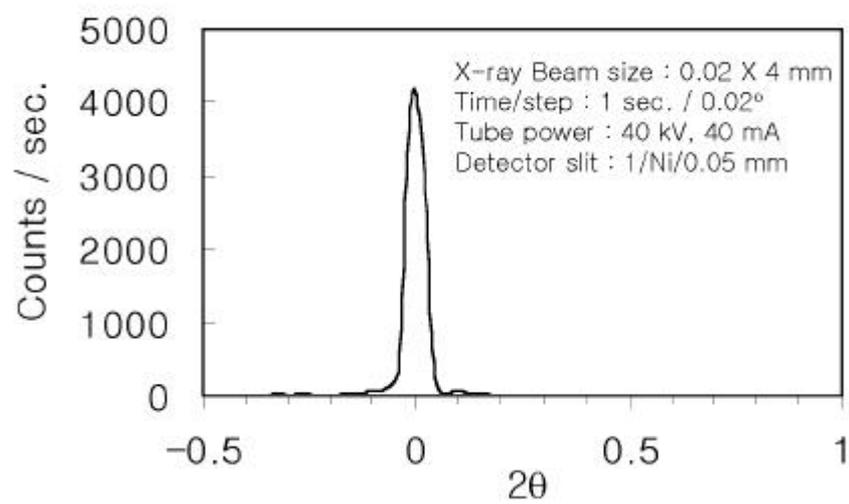


Fig. 1. Intensity profile of micro X-ray beam through a slit by conventional XRD

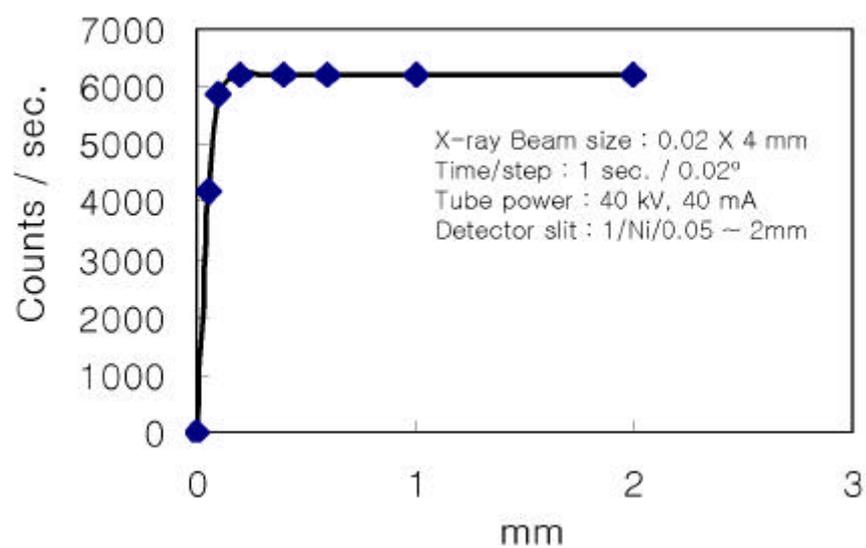


Fig. 2. Determination of the transmitted intensity of micro X-ray beam on detection slit

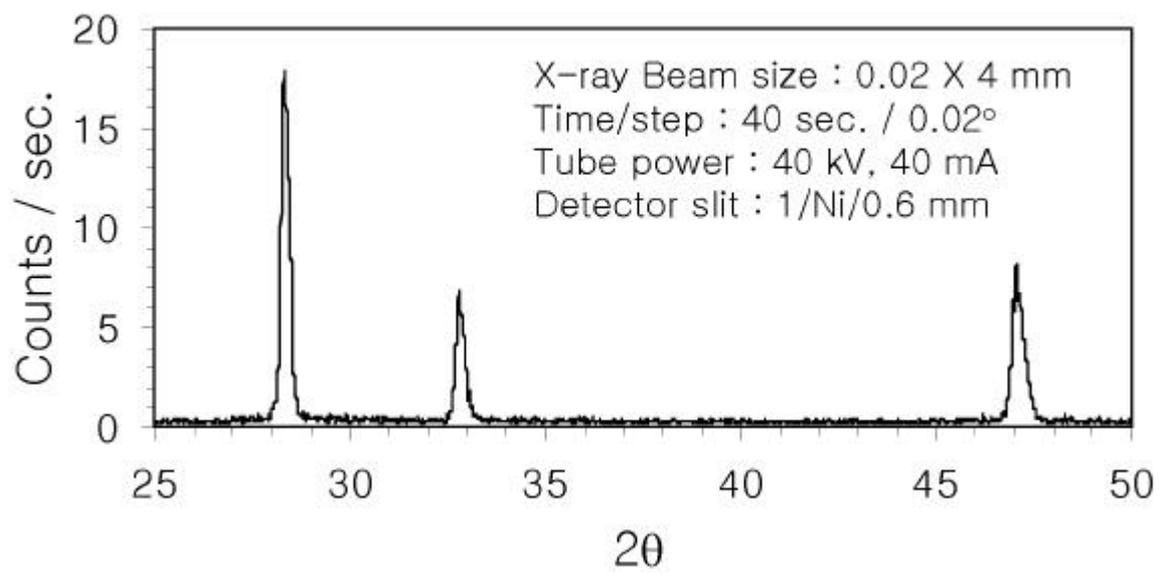


Fig. 3. Diffractogram of UO₂ pellet by conventional XRD with micro X-ray beam