

## BN

### A Study on Continuous Casting of Uranium Metal using BN Mold

150

13.5 mm

BN

가

45 mm

가

가

#### Abstract

An advanced storage technology for spent nuclear fuel was suggested by the Korea Atomic Energy Research Institute, which is that the metallic uranium is made from oxide spent fuel reduced by lithium and fabricated as rod-type with diameter 13.5 mm and stored in a canister. In order to develop the fabrication methods, continuous casting technique has been applied. We investigated the optimum casting condition for uranium continuous casting using BN mold. According to results from the experiment with adjusting the withdrawal speed and melting temperature, the rods was successfully fabricated if the withdrawal speed is reduced to less than 45 mm/min, and the controlling of the melting temperature was not as much effective factor as withdrawal speed factor.

#### 1.

가

가 . , 1994

[1] LiCl (UO<sub>2</sub>) Li ,  
1/4 ,  
가 1/2 . ,  
<sup>137</sup>Cs <sup>90</sup>Sr .

13.5 mm, 3800 mm . 가 가  
가 . [2], 1

[3, 4] , 가 가  
BN ,  
BN .

## 2.

BN , , ,  
가 , .

### 2.1

Fig. 1 13.5 mm 2.2 m  
20 kg 가 가 , 가  
가 ,  
가 , 0.5  
data acquisition system  
가 1 70 mm 40 mm R-type  
2 125 mm

K-type

2

servo motor

가

2-2.

가

ZrO<sub>2</sub>, Y<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>

Holcote#110

BN sleeve

가

start bar

, rotary pump

booster pump

10<sup>-2</sup> torr

diffusion pump

10<sup>-5</sup> torr

가 3 kHz

가

가

Ar 가

start bar

( - )

3.

Table 1

가 가

가

Table 2

가 1244 ~ 1496

가 가

2

가

가

Fig.2

2

가

Table 1. Withdrawing speed condition for uranium continuous casting.

( I )	2 mm	2 sec	45 mm/min
( II )	1 mm	3 sec	20 mm/min
( III )	1 mm	2 sec	25 mm/min

Fig.3.(c)

130cm

Fig.4

가

BN

300~1600

free energy

[5]

Table 2 . Experimental condition and results according to the withdrawing speed

		( )	가 ( )	1 ( )	2 ( )	
	( I )	1244	1137	1034	833	63cm ,
		1399	1274	1130	823	30cm ,
		1496	1288	1126	828	60cm ,
		1377	1238	1148	812	130cm ,
	( II )	1429	1278	1204	890	70 cm
	( III )	1295	1201	1056	699	84cm ,
		1294	1188	1084	686	58cm ,

free energy Fig. 5 , BN  
 uranium boride uranium nitride  
 BN sleeve SEM  
 가 Fig. 6 . Fig. 6 BN sleeve 70 μ m

4.

BN 13.5 mm  
 , 가  
 , 가 1300 mm  
 가 , 가 . BN

:

- [1] , “가  
”, KAERI-NEMAC/AR-19/94, , 1994.
- [2] , “ ”,  
99 ,
- [3] “ ” 1998
- [4] “ ” 2000
- [5] Fried Sauert, Ernst Schultze-Rhonhof, Wang Shu Sheng, Thermochemical Data of Pure Substances, Part II, p 1582-83, 1599 (1989)

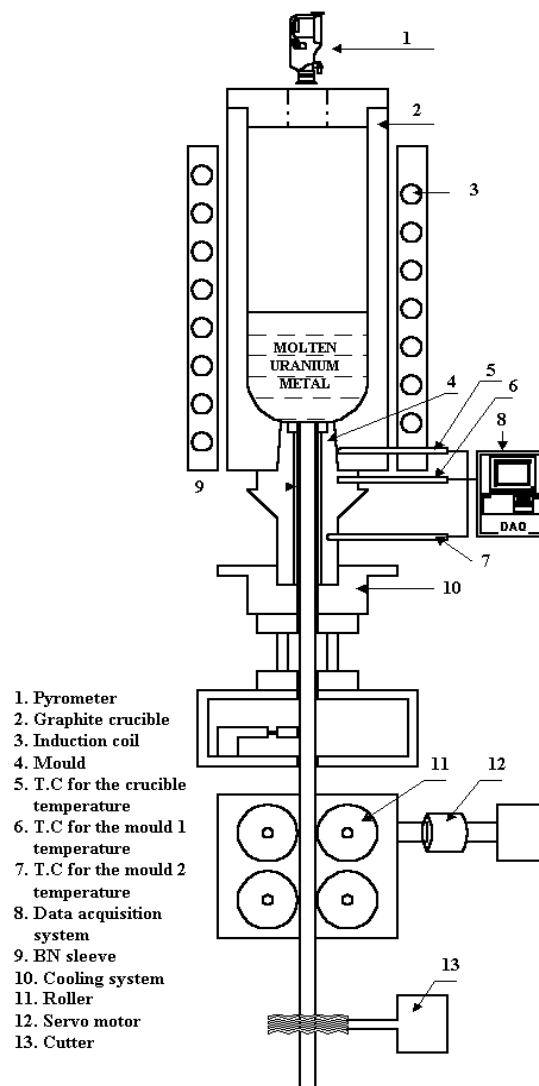


Fig 1. Schematic diagram of the uranium continuous casting apparatus

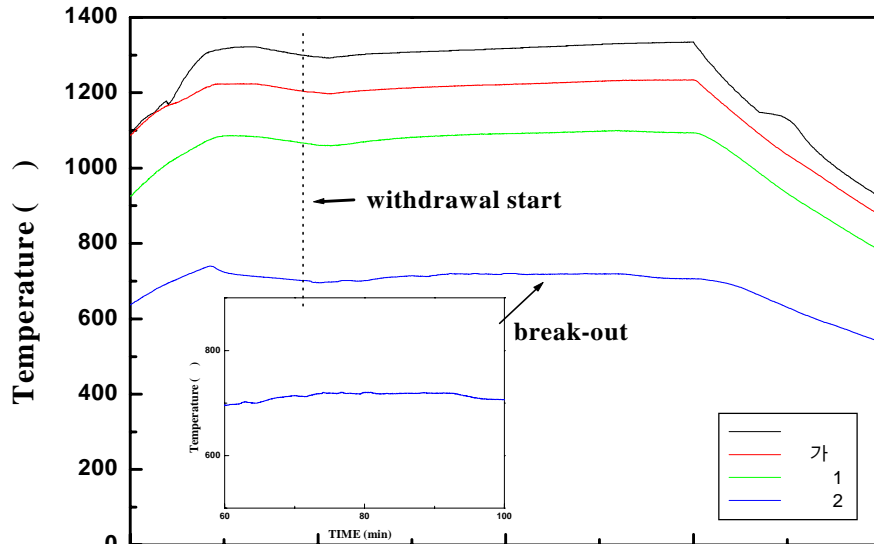


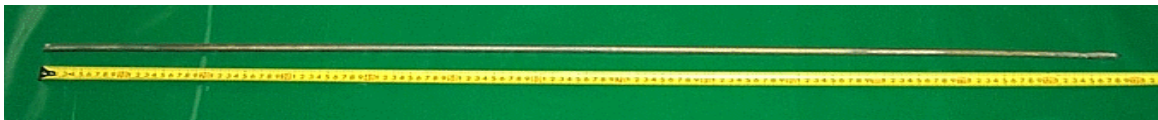
Fig. 2. Temperature change during uranium continuous casting



(a)



(b)



(c)

Fig. 3. Photograph of continuous casting uranium bar at withdrawing speed (I) condition, (b) condition, (c) condition of the table 2.

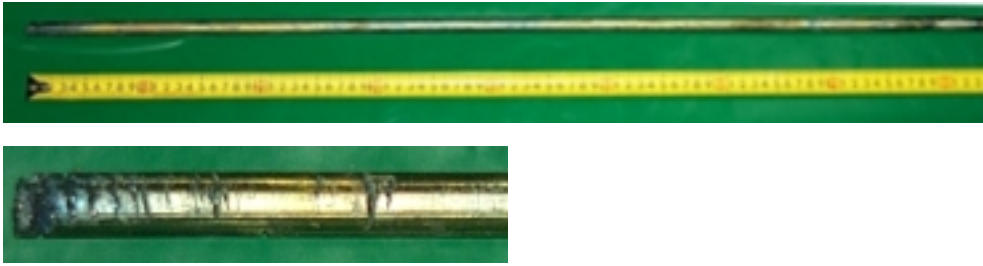


Fig. 4. Photograph of continuous casting uranium bar at condition of the table 2.

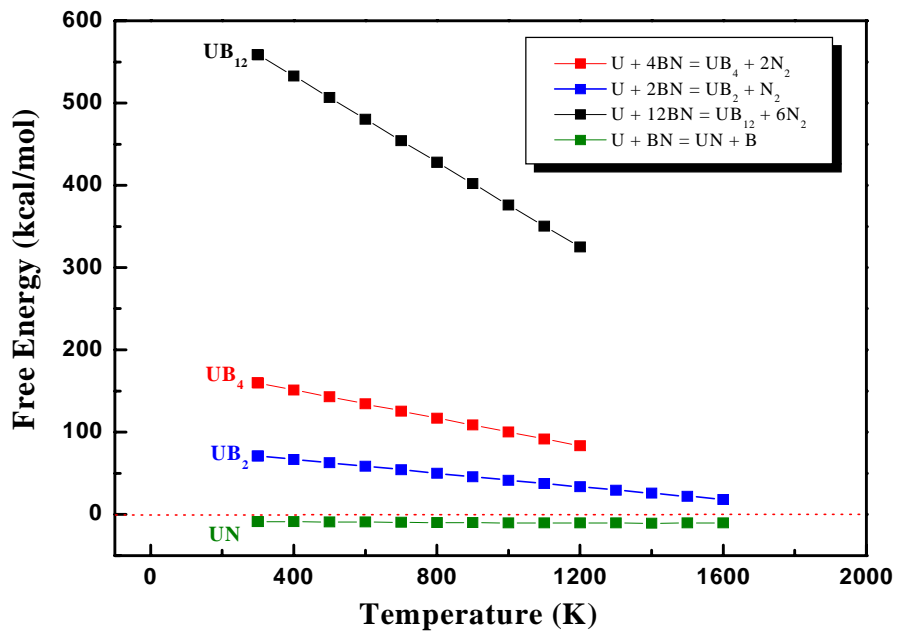


Fig. 5. The free Energy change of reaction between uranium and boron nitride

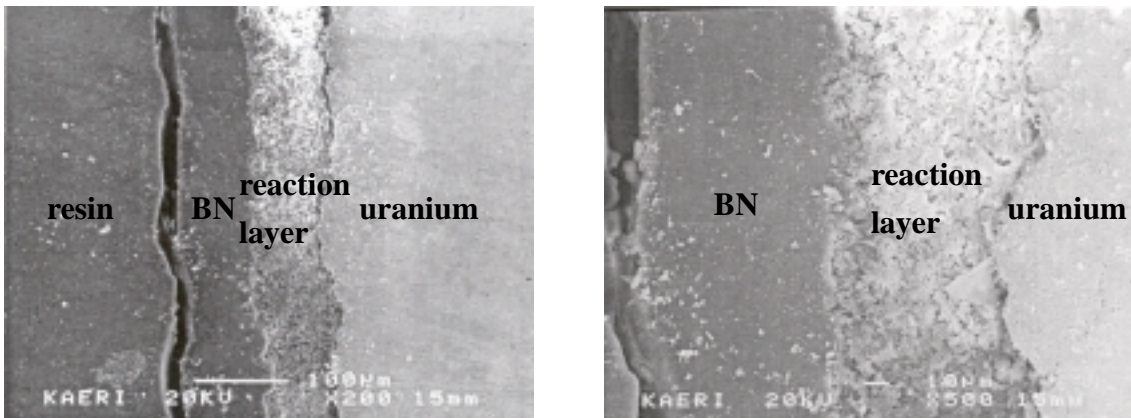


Fig 6. A reaction layer between uranium and BN by the SEM. (a)  $\times 200$ , (b)  $\times 500$