

가 BNCT

A Conceptual Design of Neutron Producing Target for Accelerator-Based BNCT and a Development of Target Cooling Method

, , , ,

17

215-4

가 BNCT
, Be-9 . Be-9
가 .
Li-7 FLUENT
Current Li-7 가

Abstract

In this study a new conceptual design of neutron producing target for accelerator-based BNCT facility was proposed and fabricated in KCCH. In the simulations Be-9 target's temperature was maintained below the melting point of target material when the cooling system is in operation. Also, we replaced the Be-9 with Li-7 in target facility and use the commercial computer code FLUENT for thermal analysis to assess the efficiency of cooling system. In result Li-7 target material does not melt down if the empty space below the target is filled with Aluminum to enlarge the contact area between the target and the surroundings.

1.

가 .
 ,
 가 가
 가 .
 가 가
 , 가 , 가 가
 , 가 가
 , 가
 가

- Deuteron Induced Reaction

가 . Serber 가
 Stripped
 . Dancoff 가
 , 가
 Stripping
 Stripping (d,n) ,
 가 ,
 DWBA . Serber
 , Serber

$$P_s(\theta)d\Omega = \frac{1}{2\pi} (1 + \alpha_d \theta^2)^{-\frac{3}{2}} ; \alpha_d = \frac{E_d}{\epsilon_d} \quad (1)$$

$$P_s(E)dE = \frac{\pi}{4} R_n R_d \frac{\varepsilon_d E_d dE}{(\varepsilon_d - E_d)^{\frac{3}{2}}} ; \theta = 0^\circ \quad (2)$$

$\varepsilon_d = 2.23$ = deuteron binding energy

E_d = deuteron kinetic energy

$R_n = 1.4A^{1/3}$ = nuclear radius

$R_d = 2.17$ = deuteron radius

(1)

가

(2) 가

Deuteron

가

. Serber ,

가 (3)

$$\sigma_b = \frac{\pi}{2} R_n R_d = 4.8 \times 10^{-26} A^{\frac{1}{3}} \text{ cm}^2 \quad (3)$$

(3)

가

가 가

가

, 가

- Proton Induced Reaction

up, (p,p'n)

가

. Multi-Body Break-

Knock out

Charge Exchange

, Direct Reaction

가

Knock-out

가

. 50 MeV

Charge-Exchange Process

(Meson Exchange)

가

가

D₂, Be, Li

. Cancer

Therapy

가

가

가

TOF

가

, 가

가

B

가

Li

Be

BNCT

⁷Li(p,n)

(Li)

가

(180)

(40 W/m-)가

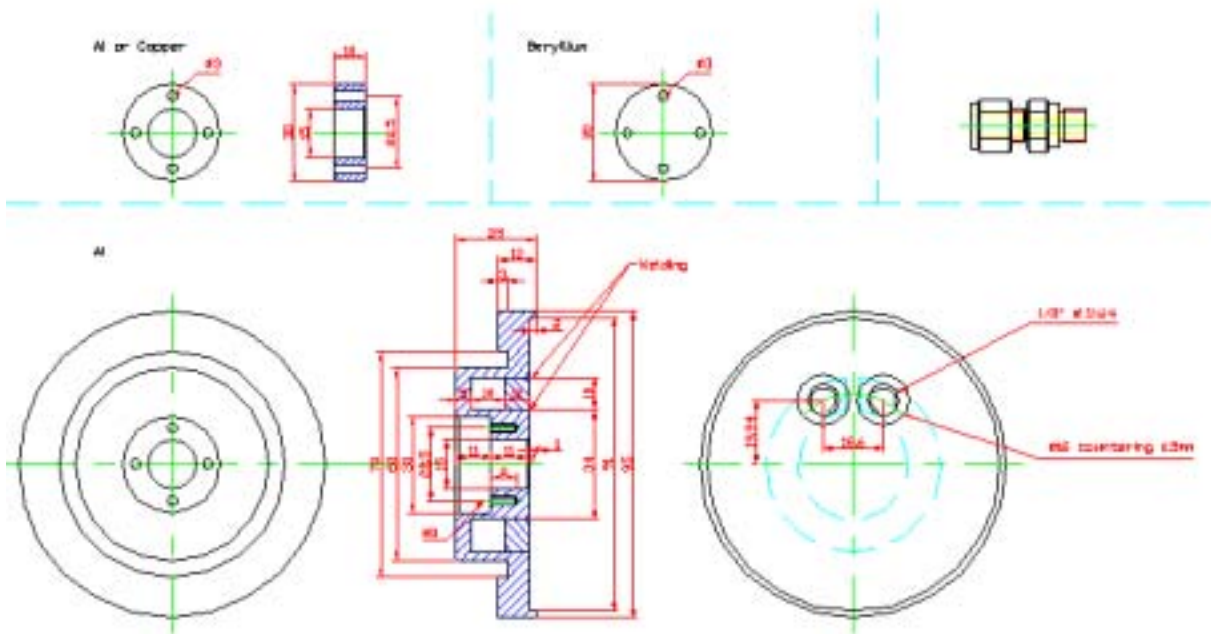
BNCT

(Proton)

⁷Li(p,n)

2.

Li Be
가가가
E 가 23 MeV
E 가 5 MeV 23 MeV
, Be 20 MeV 10^{16} (n
/ sr-s-A-MeV) 가 μA 10^{10} 가
가
Be $10^8 / \mu A \cdot s$
Be Li , Li
Be 가
1



1.

3.

Be-9

Be-9

Li-7

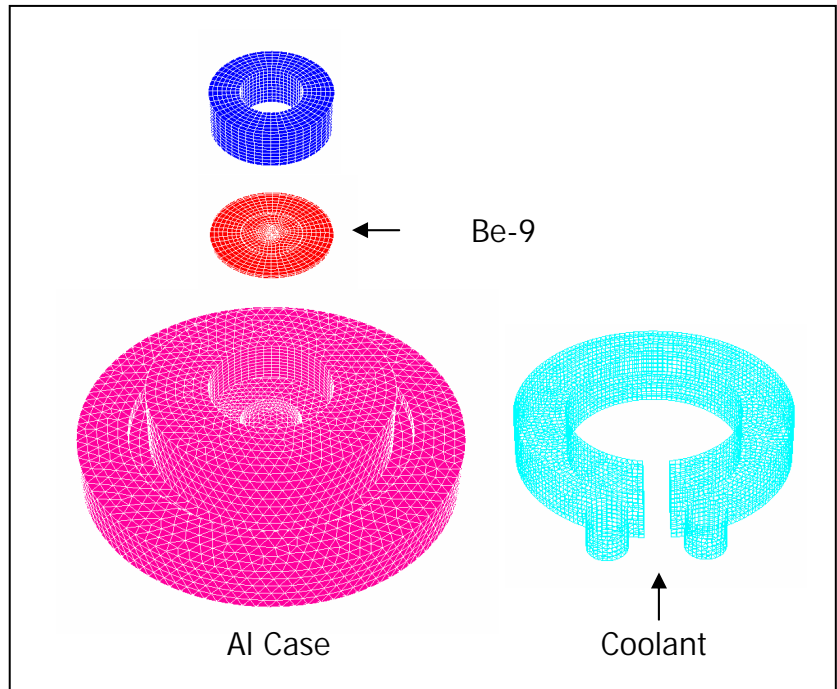
2

3 Be-9

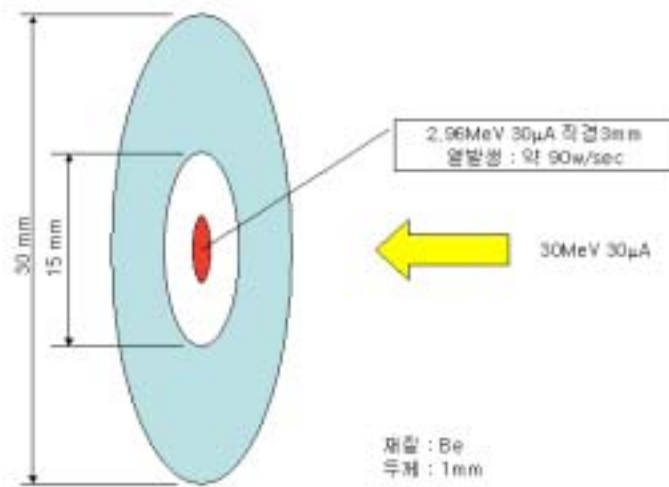
(Imparted Energy)

TLA

0.117 kg/sec



2.



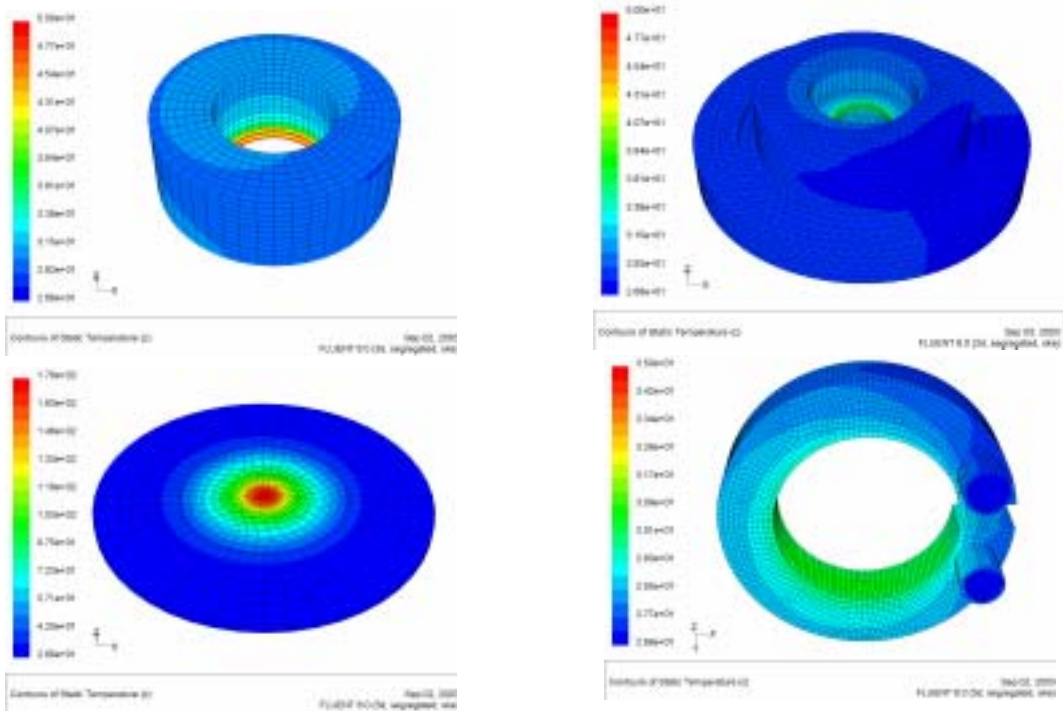
3. Be-9

FLUENT

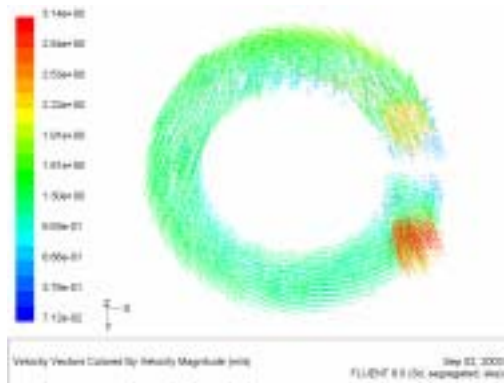
. FLUENT (FVM; Finite Volume Method) /
가 가
가

4 FLUENT Be-9 5
178 , Be-9

1273



4. Be-9



5. Be-9

Be-9 가
 Be-9 Li-7 , Li
 180 가
 2.5 MeV , 3 mm 0.66533
 MeV(TLA)가 가 Be-9
 가 0.117 kg/sec , 100 μm 가
 Li-7 가 , Be-9
 1
 가 .
 1 mm

1 Li-7

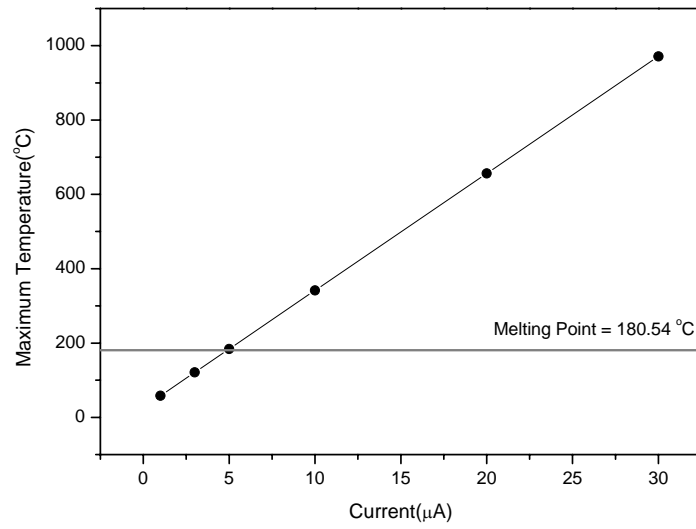
1. Li-7

	2.5 MeV, α μA, 3 mm
(Imparted Energy)	0.66533 MeV × α μA = β W
	0.117 kg/sec
	$\Pi \times (3 \text{ mm})^2 \times (100 \text{ } \mu\text{m}) / 4 = 7.0685 \times 10^{-10} \text{ m}^3$
	$\beta \text{ W} / () = \gamma \text{ W/m}^3$

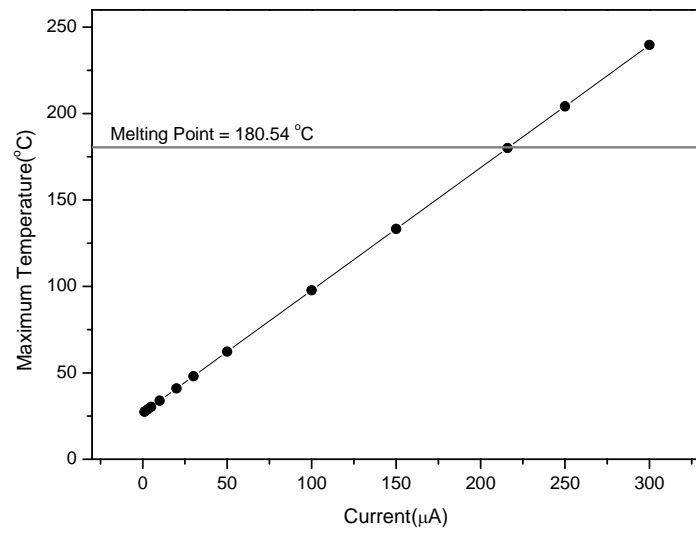
1 ,
 Current 가
 Current 가 가 Li-7
 가 Current
 가 Current
 6, 7, 8 Li-7 가 Be-9 ,

1 mm

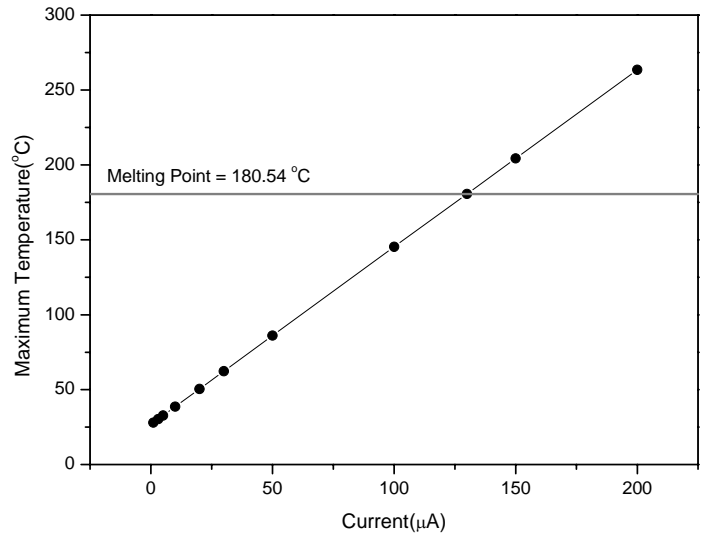
Current



6. Current
(가 Be-9)



7. Current
()



8. Current
(1 mm)

6, 7, 8

가

Current 가

1 mm

MCNP

4.

가

BNCT

Be-9

Be-9

FLUENT

가

Li-7

5 μm

Current

가

, 1 mm

Current

MCNP

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2. Y. D. Harker, J. F. Harmon, G. W. Irwin, "INEL and ISU BNCT research using a 2 MeV RFQ-Based Neutron Source," Nuclear Instruments and Methods in Physics Research B 99 (1995) 843-846.
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