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Beryllium Research in NGK and New Proposal for MTR Reflector Development

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日本ガイシ株式会社

Contents

NGK Insulators, ltd.

Company Name

NGK INSULATORS, LTD.

Date of Establishment

May 5, 1919

Paid-in Capital

69,849 Million Yen

Number of Employees

3,531 (non-consolidated)
13,210 (consolidated)

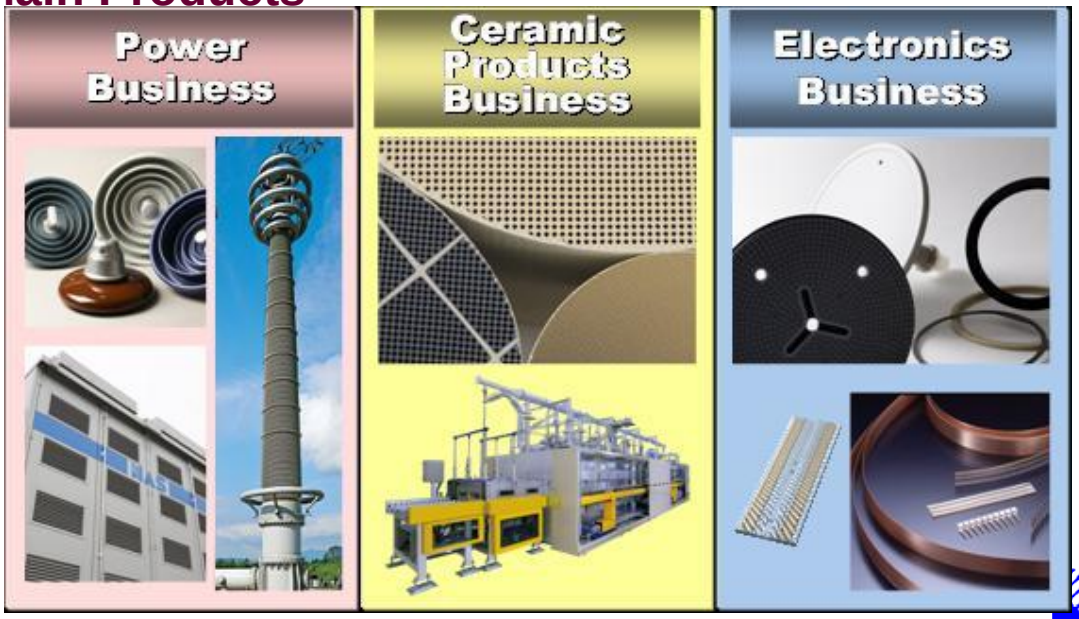
Consolidated Subsidiaries

53 companies

As of March 31, 2013

World Network

Main Products



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NGK's Beryllium Business

X-ray Machine

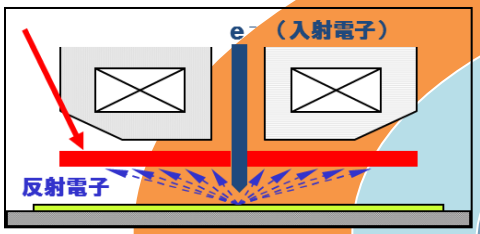
X-ray Window

Industry Machine

Be Mirror

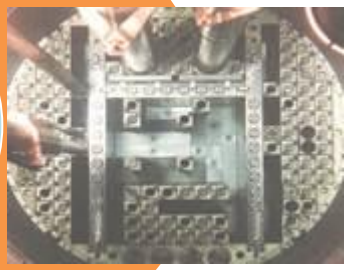
Science Equipment

Prevention Plate



Electron Microscope Parts

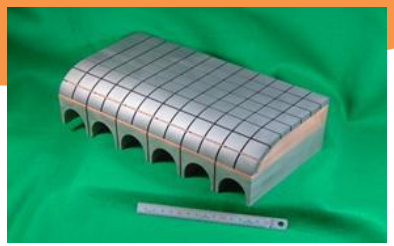
Reflector



Speaker

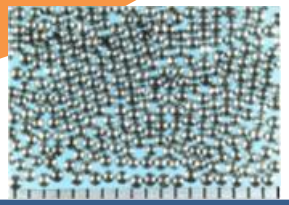
Sound Equipment

Be First Wall



Nuclear Equipment

Multiplier



Grinding

Milling/ Welding

Precision Machining

Deposition

Rotating Electrode

HIP

Light Weight

X-ray Penetration

Absorption Property

High Sound Speed

Nuclear Property

High melting Point

Be

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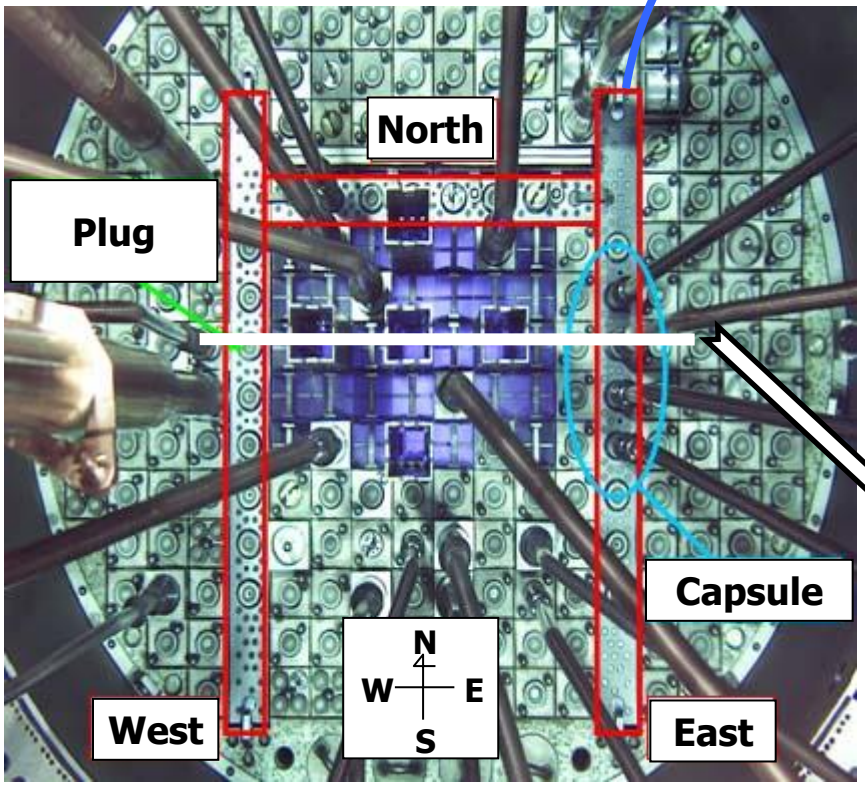
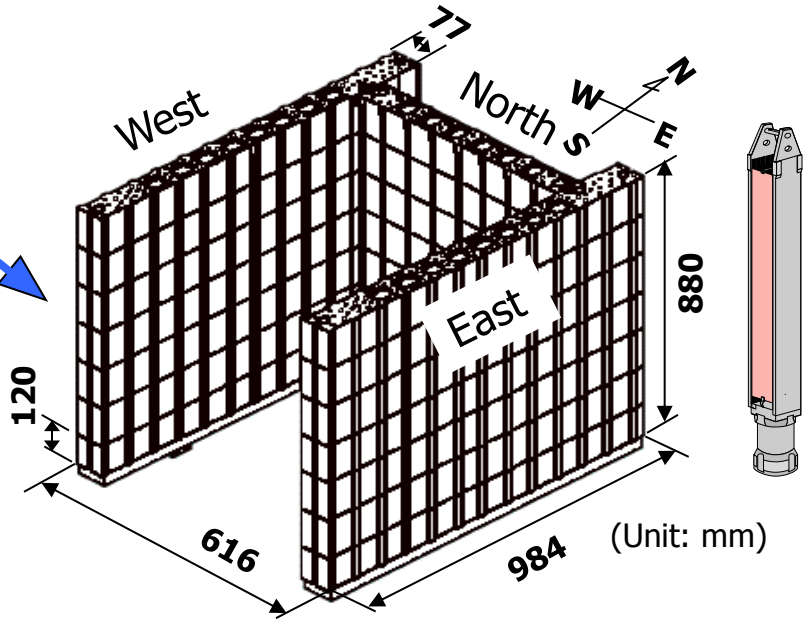
Beryllium Reflectors in MTR

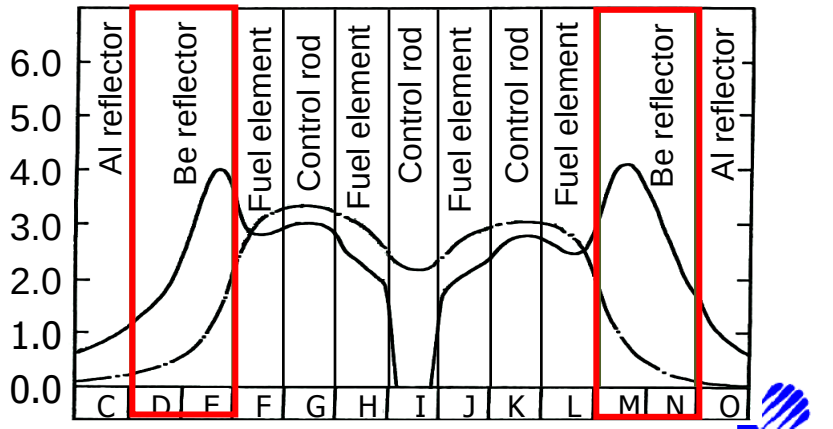
Be Reflector Frame

To enhance the neutron concentration in fuel area to irradiate the sample efficiently





Neutron flux distribution



Beryllium Reflectors in MTR

Generation	Term	Cumulative power (MWd)	Neutron Fluence ($x10^{26}m^{-2}$)	Camber (mm)
1st	**1966-1974**	**~24,000**	**0.96**	**0.71**
2nd	**1975-1983**	**~28,000**	**1.12**	**0.84**
3rd	**1984-1987**	**~25,000**	**1.00**	**0.75**
4th	**1988-1995**	**~36,000**	**1.44**	**1.24**
5th	**1996-2002**	**~29,000**	**1.15**	**1.09**
6th	**2003-2007**	**~25,000**	**1.00**	**0.93**
7th	**Installed and waiting for the operation**			

4th Generation - Design modification to improve lifetime

and 8th generation? → Modification to study for easier management

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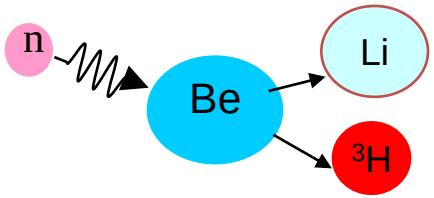
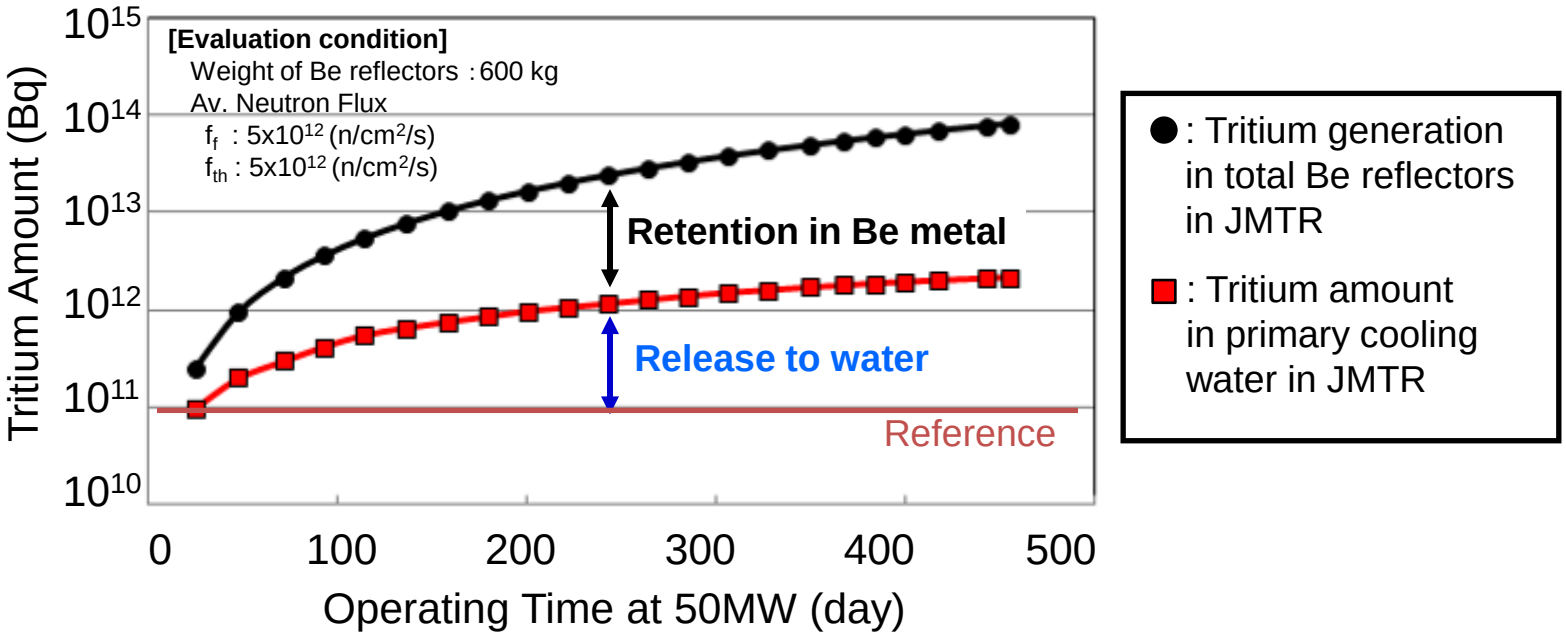
Aluminium Coating Test –Introduction-

Irradiation generates Tritium

$^{9}Be(n, \alpha)\ ^{6}He \rightarrow \beta$ decay
$\rightarrow\ ^{6}Li\ (n, \alpha)\ ^{3}H$





We need to reduce tritium release to cooling water.

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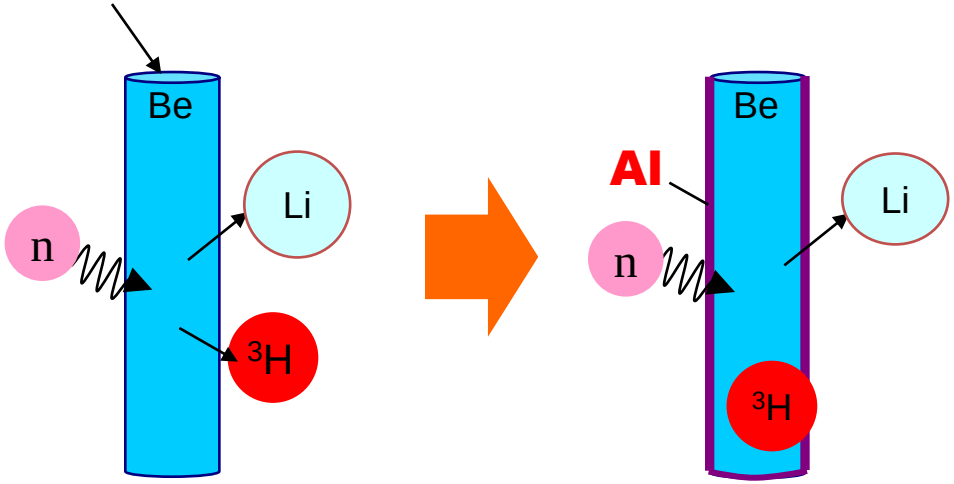
Aluminium Coating Test –Introduction-

Beryllium neutron reflector



How To Reduce ?

Coat the material on Beryllium surface

- Thickness > Recoiling distance
- Waterproof
- Minimum thickness for the reflection performance

JAEA are planning to confirm this effects with us.

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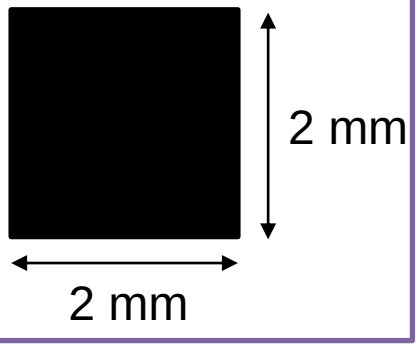
Aluminium Coating Test –Method-

Aluminium Coating Test

Substrate

Material :
Beryllium (Be > 99%)
Thickness :
0.2 mm
Surface roughness
Ra 2.0 μm



Hot Spraying Method

Supported by TOCALO

Method	Characteristic
Arc Process (Wire Process)	* Easy to spray on several materials. * Easy to spray large-capacity.
High Velocity Oxy-Fuel	* Possible to make an ultra-fine film. * Possible to spray rapidly.
Atmospheric Plasma Spraying	* Possible to make the adhesion strongly.

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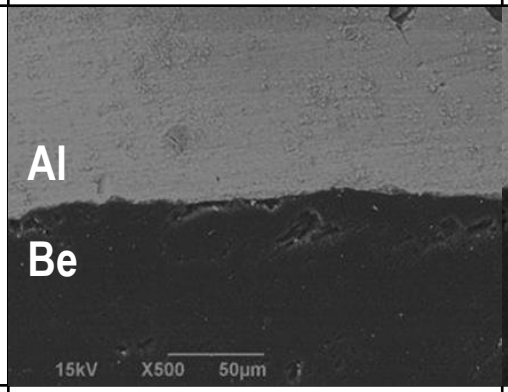
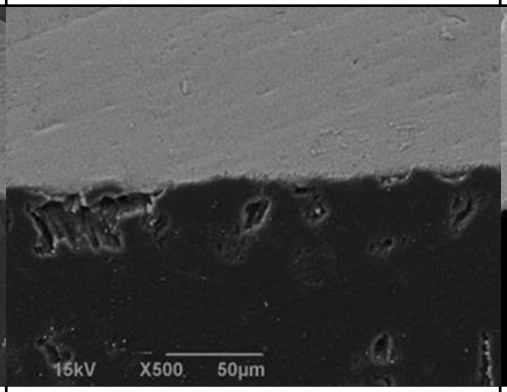
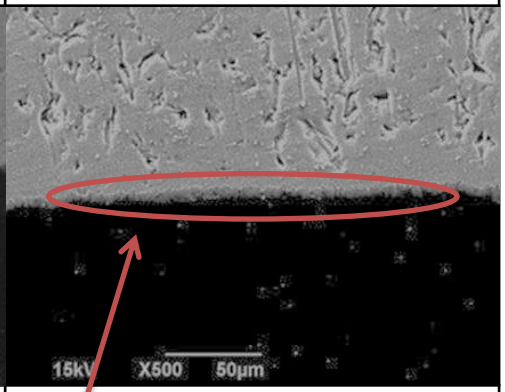
Aluminium Coating Test –Result-

	Arc Process	High Velocity Oxy-Fuel	Atmospheric Plasma Spraying
Secondary-Electron images			
Adhesion	Good	Good	Very Good

Intermediate layer in Atmospehic Plasma Spraying.

→ Strongly adhesion was expected.

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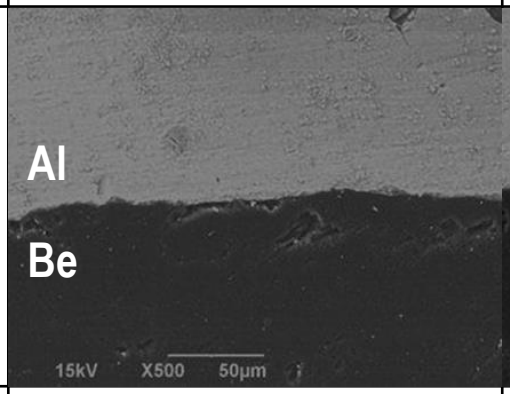
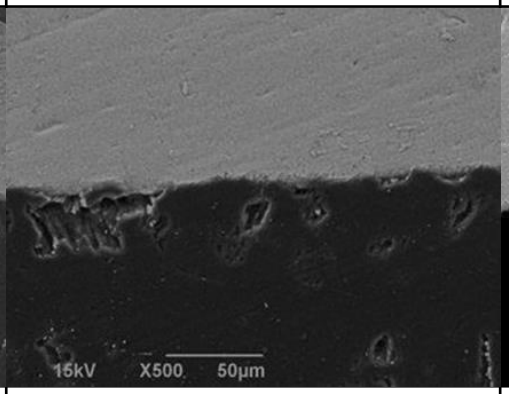
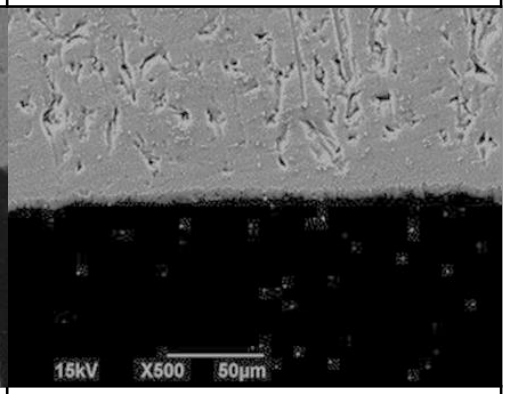
Aluminium Coating Test –Result-

	Arc Process	High Velocity Oxy-Fuel	Atmospheric Plasma Spraying
Secondary-Electron images			
Adhesion	Good	Good	Very Good
Void's Number	Middle	A Few	Many
Void's Size	Middle	Smaller	Bigger

Void's Number and Size.

→ **Influence to be Infiltrated the Water?**

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Future Plan

1st STEP : Compared Only the Aluminium Film

To confirm conditions not to influence the cooling water.

2nd STEP : Neutron Irradiation Test

To confirm conditions to protect the recoiled tritium.

Thank you for your attention