A Study on the Material Properties of Nuclear Graphite IG-110 under Neutron Irradiation.

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1. Introduction

Nuclear graphite has a good thermal conductivity, high melting point, high chemical stability, and with excellent resisting on both irradiation and corrosion. Nuclear graphite also has a resistance to relatively high fast neutron fluence. In this study, Shore hardness test and compressive test of nuclear graphite IG-110 were conducted under neutron irradiation.

2. Tests and Methods

2.1 Properties of nuclear graphite IG-110

In this study, the isotropic graphite IG-110 of Japan ToyoTanso was investigated. The material properties of nuclear graphite IG-110 were shown in Table I.

Table I: Properties of nuclear graphite IG-110.[1]

Properties	IG-110
Bulk Density (g/cm^3)	1.76
Young's Modulus	8.93
Flexural Strength (MPa)	37.4
Compressive Strength (MPa)	76.8
Shore Hardness	51
Immpurity (ppm)	<20
Ave.Grain Size (μ m)	10

2.2 Neutron irradiation

In order to neutron irradiation of graphite IG-110, the eight cylindrical compressive specimens with 7 mm diameter and 14 mm length and the six cylindrical Shore hardness specimens with 15 mm diameter and 8 mm length were prepared. Four compressive specimens and three hardness specimens were neutron irradiated at LH irradiation test hole with 1.42 ~ 5.52 x 10^{-7} mrem/hr and 24 days. Fig. 1 shows the nuclear graphite IG-110 before neutron irradiation.

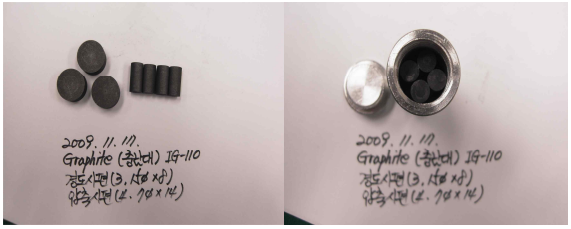


Fig. 1 Compressive and Shore hardness specimens before neutron irradiation.

2.3 Shore hardness test

Shore hardness test was conducted by SATO Shore hardness tester as shown in Fig. 2. Test was performed 10 times each specimen. Irradiated and non-irradiated graphite specimens test results are as shown in table. II.

(a)Non-irradiation (b)Irradiation

Fig. 2 Shore hardness test of graphite IG-110.

Table II: Shore hardness test results of Nuclear Graphite IG-110.

	1	2	3	Ave.
Non-irradiation	49.6	49.6	49.5	49.6
irradiation	35.7	35.1	35.7	35.5

2.4 Compressive test

In order to measure the compressive strength, compressive test was conducted by MTS-810 as shown in Fig. 3. Constant displacement control method was used for load control and applied load velocity was 0.1 mm/min. Compressive strength is defined as equation (1).

(a)Non-irradiation (b)Irradiation

Fig. 3 The specimens of isotropic graphite IG-110 compressive test by MTS-810.

$$\sigma_c = \frac{P}{A}$$

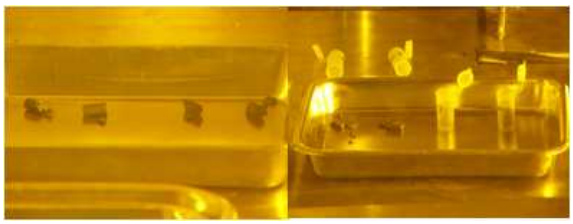
σ_c : Compressive Strength (MPa)

P : Fracture Load (N)

A : Area (mm^2)

.....(1)[2]

Fig. 4 shows the fractured shape of the compressive specimens.



(a)Non-irradiation (b)Irradiation

Fig. 4 Fractured shape of isotropic graphite IG-110 .

3. Results

The hardness of non-irradiated specimens was 49.6 and irradiated specimens value was 35.5. Hardness value was decreased by neutron irradiation.

Fig. 5 shows the load-displacement curve of graphite IG-110. Compressive strength of nuclear graphite IG-110 as shown in Fig. 6.

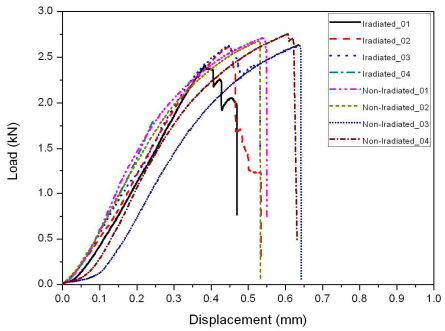


Fig. 5 Load-displacement of IG-110 graphite.

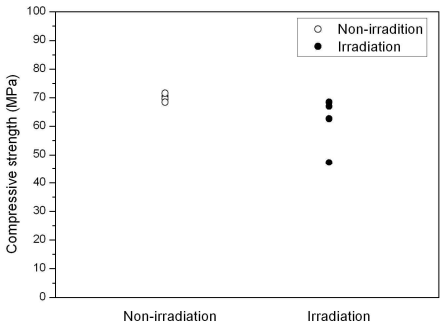


Fig. 6 Compressive strength of IG-110 graphite.

The compressive strength of non-irradiated specimens value was 70.0 MPa and irradiated specimens value was 61.6 MPa.

4. Conclusions

Shore hardness and compressive test of nuclear graphite IG-110 under neutron irradiation was conducted. Non-irradiated specimen's Shore hardness value was 49.6 and compressive strength value was 70.0 MPa. Irradiated specimen's Shore hardness value was 35.5 and compressive strength value was 61.6 MPa. In Shore hardness test, the neutron irradiation affected to specimens. By contrast, compressive strength value was similar.

REFERENCES

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Acknowledgment

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