

## High Temperature Compressive Test of Nuclear Graphite IG-110

Jeong-Hyun Kim<sup>a</sup>, Young-Shin Lee<sup>b\*</sup>, Jae-Hoon Kim<sup>a</sup>, Yong-Keun Yoon<sup>a</sup>,  
Young-Hwan Kang<sup>c</sup>, Kee-Nam Choo<sup>c</sup>, Man-Soon Cho<sup>c</sup>

<sup>a</sup> BK21 Mechatronics Group, Dept. of Mechanical Design Eng., Chungnam National University, Daejeon, Korea.

<sup>b</sup> Corresponding Author, Director of BK21 Mechatronics Group, Chungnam National University, Daejeon, Korea.

<sup>c</sup> Korea Atomic Energy Research Institute, Daejeon, Korea.

\*Corresponding author: leeys@cnu.ac.kr

### 1. Introduction

Graphite has a good thermal conductivity, high melting point, very good effect of neutron degradation and do not reduce mechanical properties. Also it is very stable chemically in a non-oxidizing. Due to these characteristics, nuclear graphite are applied to structural components and moderator, or reflector for high temperature reactor. There are many researches has been performed on the structural characteristics of nuclear graphite. The most of previous researches were restricted to the room temperature conditions.

In this study, the compressive strength of graphite at high temperature was investigated. Test materials is IG-110, and test equipment is MTS-810. IG-110 specimens were fabricated for high temperature compression tests according to ASTM C695-21 standard. Nuclear graphite experiments were performed with room temperature and 300°C, 400°C, 500°C conditions.

### 2. Experiment

#### 2.1 Property of graphite IG-110

The material properties of graphite IG-110 were shown in Table I. IG-110 get the density of 1.76 g/cm<sup>3</sup>, Young's modulus of 8.93 GPa, Shore hardness of 51, bending strength of 37.4 MPa and compressive strength of 76.8 MPa.

Table I: Properties of isotropic graphite IG-110.

Material	Compressive Strength (MPa)	Hardness Shore	Bending Strength (MPa)	Density (g/cm <sup>3</sup> )	Tensile Strength (MPa)	Young's Modulus (MPa)
IG-110	76.8	51	37.4	1.76	25	8.93

#### 2.2 Compressive test

IG-110 specimens were fabricated for high temperature compression tests according to ASTM C695-21 standard. The cylindrical specimens is 9.5 mm diameter and 19 mm length. Nuclear graphite experiments were performed with room temperature and 300°C, 400°C, 500°C conditions. The equation (1) was used to calculate the compressive strength.

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

$\sigma_c$  : Compressive Strength (MPa)  
W : Fracture Load (N)  
A : Area (mm<sup>2</sup>)

(1)

Test was performed using MTS-810(10 ton). Specimens were enough heating in the furnace. Temperature of graphite was measured using thermocouple. Specimens of graphites were heating for 10 min heated at steady temperature. Fig. 1 shows the compressive test equipment MTS-810(10 ton). Constant displacement control method was used for load control and applied load velocity was 0.5 mm/min. Fig. 2 show the graphite heating by heating chamber. Fig. 3 shows the fracture form of the specimen. The tests were performed three-times at each temperature.

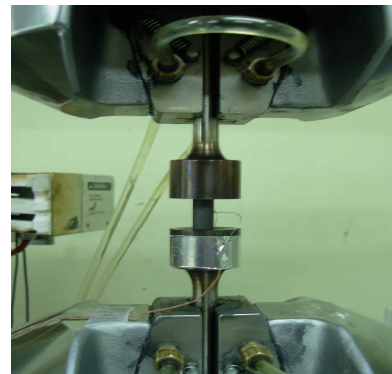


Fig. 1 Compressive test by MTS-810(10 ton).



Fig. 2 Experimental setup with heating chamber.

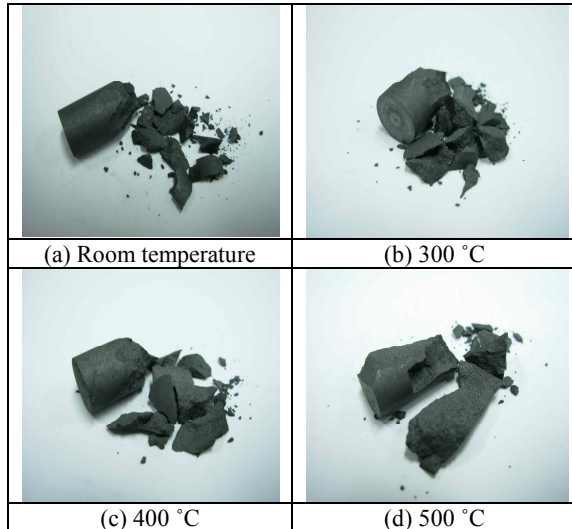


Fig. 3 Fracture shape of graphite IG-110.  
(a) Room temperature, (b) 300 °C, (c) 400 °C, (d) 500 °C

### 3. Results

In this study, 12 experiments were performed. Fig. 4 show the Load-Displacement curve of graphite IG-110. The compressive strength of nuclear graphite IG-110 as shown in Fig. 5.

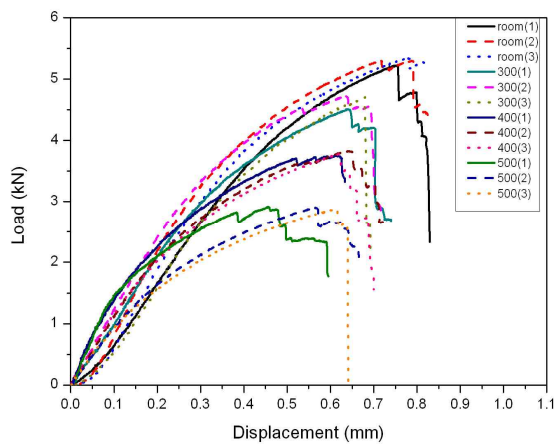


Fig. 4 Load-Displacement of IG-110 graphite.

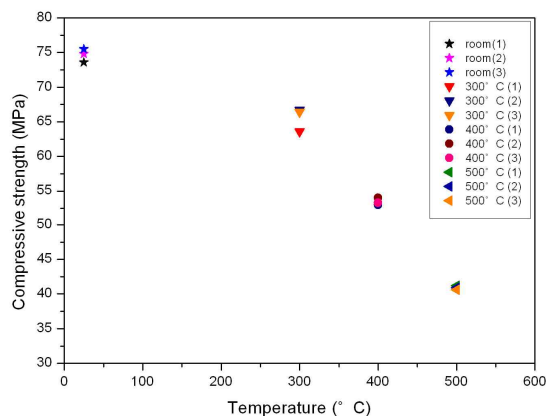


Fig. 5 Compressive strength of IG-110 graphite.

In room temperature condition, the compressive strength of specimens value was 74.6 MPa and compressive strength of specimens value was 65.5 MPa at 300 °C condition. In 400 °C temperature condition, the compressive strength of specimens value was 53.4 MPa. compressive strength of specimens value was 40.9 MPa at 500 °C .

### 3. Conclusions

In this study, compressive test of nuclear graphite IG-110 with room temperature and 300 °C , 400 °C , 500 °C conditions. In room temperature and 300 °C , 400 °C , 500 °C conditions, the compressive strength of specimens value was 74.6 MPa, 65.5 MPa, 53.4 MPa, and 40.9 MPa. According to rising temperature, compressive strength was decreased.

### REFERENCES

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