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THE EFFECT OF PRESSURE IN BINDERS ON IMPROVED JOINING STRENGTH OF ISOTROPIC BULK GRAPHITE

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Introduction

Isotropic bulk graphite is used in various industries as heating elements, crucibles, and electrodes. Generally, bulk graphite is obtained through a set of processes: powder mixing, shaping, carbonization, impregnation, re-carbonization, and graphitization. Bulk graphite is difficult to fabricate into large shapes, and produces a high amount of scrap material [1, 2]. To resolve these issues, some researchers have developed methods of joining small volumes of bulk graphite[3]. However, the joining characteristics of bulk graphite have not been extensively studied. This study examined the effect of pressure in binders on the joining strength of bulk graphite.

Materials and Methods

Specimens of isotropic bulk graphite (Tokai Carbon, Japan) measuring 10x10x25mm were used in joining with an organic binder. After applying the binder to the surfaces of two bulk graphite specimens, one of the joining surfaces was subject to a pressure of 20MPa (Case 1), while the other (Case 2) was subject to pressure resulting from the weight of the specimen itself (441.3Pa). The two specimens were cured in an oven at 150℃ for one hour and then joined. The cured specimens were carbonized under N_2 by raising the temperature at 1℃/min up to 1000℃ and maintaining the same conditions for one hour. This was followed by a final round of joining. The flow rate of N_2 at this point was 2l/min. Three specimens were fabricated for strength measurement, and one for microstructural analysis.
A three-point flexural test (see KS L 3409) was performed to measure the joining strength of the specimens. After micro-polishing the longitudinal section of the specimens up to 0.25㎛, the thickness and the shape of the joining layers were observed under an optical microscope.

Results and Discussion

Figure 1 presents a graph of the flexural strength of specimens. Case 1 had an average flexural strength of 11.42MPa, higher than that of Case 2 at 9.77MPa and with a larger standard deviation. **Figure 2** shows an optical microscopic image of the joining layers. The thickness of the joining layers was 11.4㎛ for Case 1 and 254.3 ㎛ for Case 2. Large pores were also observed in the Case 2 specimens. This can be traced to expansion of volatile matter produced from the curing

and carbonization of binder in unpressed specimens.

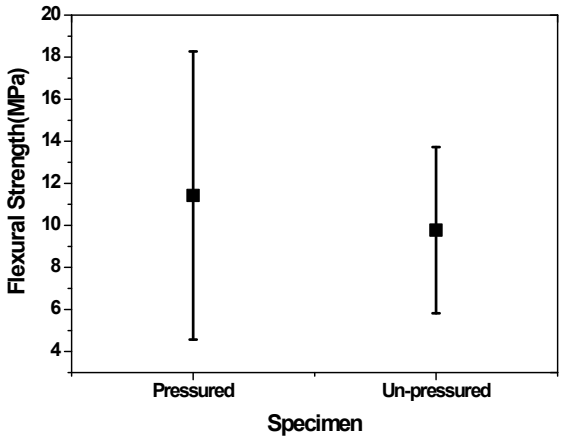

Figure 1. A flexural strength graph of joined graphites

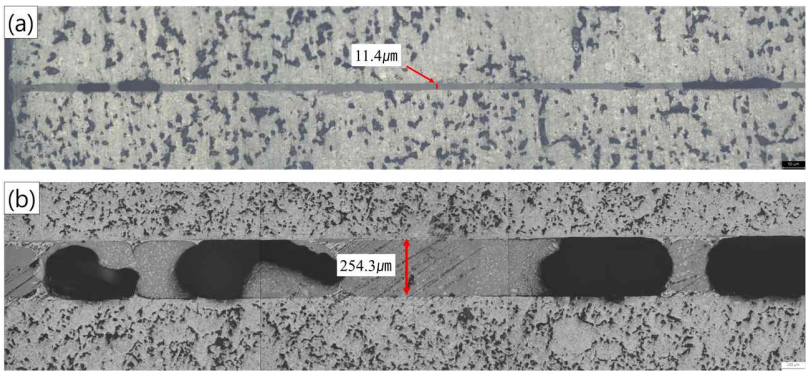

Figure 2. Optical microscopic images of (a) pressed and (b) un-pressed joining layers

Conclusions

This study examined the effect of pressure in binders on the joining strength of bulk graphite. An analysis of flexural strength showed that flexural strength was lower for unpressed joining layers than pressed layers. When examined with an optical microscope, large pores were observed in unpressed joining layers. These results indicate that higher strength can be obtained by applying pressure during the joining of bulk graphite.

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