POSTER

CARBONIZATION AND SURFACE CHARACTERISTICS OF γ-IRRADIATED BAMBOO CELLULOSE

Yusuke Nakayama, Yasuhiro Koezuka, Hideki Yamasaki, Kazuhiro Fujita, and Kenji Hosokawa*

Ehime Univ., Fac. Engineering, Matsuyama, Ehime 790 JAPAN.
*Kyoto Prefect. Univ., Fac. Living Sci., Kyoto 606 JAPAN.

INTRODUCTION

Previous studies [1,2] have shown that γ-irradiated almond shell, olive stone, and bamboo show appreciable changes in the carbonization process resulting in a char with larger yields and surface area than the char obtained from the non-irradiated precursor.

This present paper shows the results of carbonization and carbonized products of γ-ray irradiated bamboo cellulose. Then effects on the carbonization process, sintering character and carbonized materials were studied.

EXPERIMENTAL

Commercial bamboo cellulose(BA) was used without further treatments. The samples were irradiated by the 4.1 PBq Co-60 unit of the JAERI. The BA was γ-irradiated at room temperature with a dose rate of 4.5×10^2 C/(kg.h). There were seven dose stages from the minimum of 1.0×10^3 C/kg to the maximum of 7.5×10^4 C/kg. A thermal analysis and the FT-IR spectra were studied. No radioactivity is induced by the irradiation.

RESULTS AND DISCUSSIONS

After irradiation, the color of bamboo cellulose became browner, and darkened with increasing γ-ray dosage. After irradiation BA weight was reduced to 0.973, 0.964, and 0.952 for 1×10^3, 2.5×10^4, and 7.5×10^4 C/kg, respectively.

Table 1. C:H:O ratio of non- and γ-irradiated bamboo cellulose (normalized as C=6)

Dose (C/kg)	H	O	2xO-H
none	9.19	4.36	-0.47
$1.0\text{x}10^3$	9.31	4.51	-0.29
$2.5\text{x}10^3$	9.33	4.54	-0.25
$5.0\text{x}10^3$	9.39	4.58	-0.23
$7.5\text{x}10^3$	9.13	4.62	0.11
$1.0\text{x}10^4$	9.50	4.71	-0.08
$2.5\text{x}10^4$	9.25	4.48	-0.29
$7.5\text{x}10^4$	9.12	4.55	-0.02

Table 1 shows C:H:O ratio, which is calculated using values of C and H obtained from the elemental analysis of BA. The C:H ratio of γ-irradiated BA is at its - maximum at 1.0×104 BA and noticeably decreases at higher irradiation dosages. The C:O ratio also increased up to 1.0×10^4 BA, and also decreased with higher irradiation dosages, but with smaller decreases compared with C:H. Those values suggest about 31 percent or more of the C-H and/or C-O bonds in the BA chemical structure units were damaged and at the same time these BA reacted with oxygen in the air.

In the FT-IR spectra of γ-irradiated BA, new peaks appeared at 1735 cm^{-1}, and become stronger with γ-ray irradiation.

The TG curves of γ -irradiated BA show a rapid weight loss around 260 ℃ to 360 ℃. Decomposition started at a lower temperature with the γ -ray irradiation.

Table 2 Carbon yield and apparent surface area of non- and γ-irradiated bamboo cellulose. carbonized at 800 ℃, nitrogen

Dose (C/kg)	carbon yields (%)	carbon/ carbon (%)	apparent surface area(m^2/g)
0	23.8	50.1	1.7
$1.0x10^3$	24.0	51.3	1.7
$2.5x10^3$	24.5	52.4	20
$5.0x10^3$	24.7	53.1	200
$7.5x10^3$	25.1	54.1	120
$1.0x10^4$	25.6	55.8	42
$2.5x10^4$	26.8	57.0	290
$7.5x10^4$	29.9	64.0	100

*(carbon yield)/(carbon contents in precursors)

Carbon yields and apparent surface area at 800℃ heated chars are given in Table 2, where it is shown that the yields of irradiated samples are larger than that of BA (this is being due to tar formation inhibition) and they increase with irradiation dosage. The hardness of the char BA increases with irradiation along with the observed sintering of char and the shrink ratio.

Apparent surface areas of γ -irradiated BA carbon carbonized at 800 ℃ are about 2 m^2/g. This area increased with γ -ray dosage and a maximum value of 290 was obtained at 2.5×10^4 BA, but too much irradiation caused a decrease of the surface area, due to the sintering of the char.

Figure 1 summarizes SEM pictures of non-, 2.5×10^4 BA, and 7.5×10^4 BA carbons. The pictures suggest that non-irradiated BA char is loose and irregular, while 2.5×10^4BA char kept its tight regular shape, and 7.5×10^4 BA char showed cracks on the stem surface from too much sintering . The conditions of BA char in the SEM pictures suggest good correlations with the carbon yields and the surface areas. These results suggest that the best BA char is obtainable from 2.5×10^4 C/kg irradiated BA.

CONCLUSIONS

(1) Carbon yield increased with γ -ray irradiation.

(2)Apparent surface area(nitrogen) of the bamboo cellulose char increased with γ -ray irradiation. A maximum value was obtained at 2.5×10^4 C/kg. And too much irradiation caused a decrease of surface area,due to tar carbonization and sintering of char.

3) Controlling γ -ray doses, atmosphere and carbonization conditions would produce more functional materials from bamboo cellulose, such as activated carbon fiber.

REFERENCES

[1] Y.NAKAYAMA, K.SHIMIZU, K.HOSOKAWA, and P.Rodriguez-Reinoso, Extended Abstr. 21st Biennial Conf. on Carbon '93(Buffalo) 361 (1993).

[2] Y.NAKAYAMA, C.YAMASAKI, and K.HOSOKAWA, Extended Abstr. 21st Biennial Conf. on Carbon '93(Buffalo) 363 (1993).

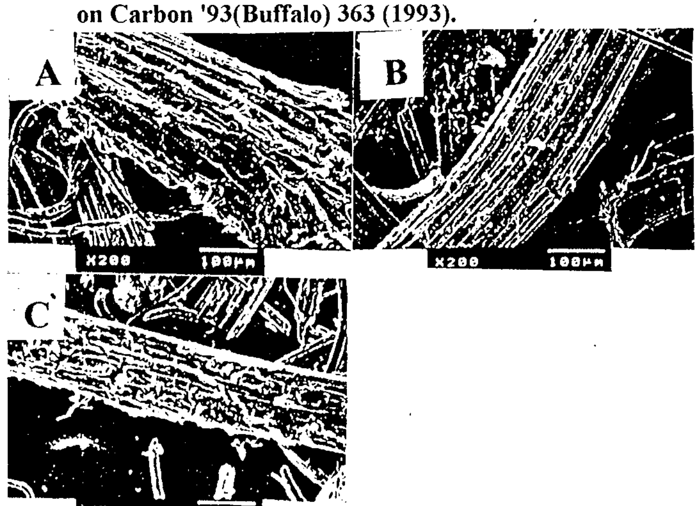

Figure 1.SEM pictures of BA char.
A: none, B: 2.5×10^4 C/kg, C: 7.5×10^4 C/kg.