

## HPP-g-GMA

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(2001 9 26 , 2001 12 22 )

### Synthesis of Aminated Hollow PP-g-GMA Fibrous Ion-Exchanger for Separation of Urokinase

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*(Received September 26, 2001; accepted December 22, 2001)*

: E - beam HPP - g - GMA  
HPP - g - GMA . GMA 가 가  
가 GMA 가 1.46 M 130% .  
가 , 100% 37.4%  
HPP - g - GMA 3.78 meq/g  
BET HPP - g - GMA  
54.83 m<sup>2</sup>/g, 26 Å 가  
SEM , 가  
가 .

**ABSTRACT :** We synthesized HPP-g-GMA copolymer using pre-irradiation method by E-beam and aminated HPP-g-GMA using amination reaction. Degree of grafting increased with increasing GMA monomer concentration and showed the maximum value of 130% at 1.46 M of GMA. The degree of amination increased with increasing the degree of grafting. When the degree of grafting was 100%, degree of amination showed the maximum value of 37.4%. The ion exchange capacity of aminated HPP-g-GMA was about 3.78 meq/g, and it showed remarkable adsorption ability of hollow fiber ion exchanger. Through the BET analysis, the surface area of aminated HPP-g-GMA was 54.83 m<sup>2</sup>/g and the mean pore size was 26 Å. These showed the decrease of surface area and the slight increase of the mean pore size. SEM results show that the thickness of fiber increased after the step of reaction and there pore blocking phenomena was not observed. The aminated HPP-g-GMA was synthesized successfully and found to be suitable for the adsorption and separation of anion.

**Keywords :** hollow fiber, e-beam, pre-irradiation, graft polymerization, amination, urokinase.

HPP - g - GMA

nase

Hegazy

, 가

.<sup>13</sup> , Okamoto

<sup>14</sup>

가

가

(thrombus)

.<sup>1</sup>

가

fibrin

가

가

Nho

<sup>15</sup>

가

urokinase

, Kim

<sup>16</sup> E - beam

plasminogen  
serine protease

plasmin

urokinase

.<sup>2,3</sup>

가

Urokinase 1951

hollow PP

hollow PP - g - GMA(HPP - g -

GMA)

urokinase

FT - IR, BET, SEM

8

5,6

7

.<sup>4</sup>

Urokinase 1960

.<sup>9</sup>

hollow PP - g - GMA

30 80 µg/L

urokinase

.<sup>10</sup>

가

bentonite

hollow PP

.<sup>11</sup>

MEMBRANA

bentonite

0.2 µm,

1800 µm,

2250 µm

가

>S6/2 model  
methacrylate, C<sub>7</sub>H<sub>10</sub>O<sub>3</sub>)

GMA (glycidyl

Junsei Chemical

, Mohr's salt

urokinase

Wako Pure Chemical

ammonium iron( )

가 가

sulfate(FeSO<sub>4</sub>(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> · 6H<sub>2</sub>O)

가

tritmethyamine

Nal Aldrich Chemical

.<sup>12</sup>

uroki -

95%

**Table 1. Synthetic Conditions of HPP-g-GMA Copolymer by E-Beam Accelerator**

no.	GMA monomer (mole)	Mohr's salt ( $\times 10^{-3}$ mole)	sulfuric acid (M)
1	1.10	0.5	0.1
2	1.28	0.5	0.1
3	1.46	0.5	0.1
4	1.65	0.5	0.1
5	1.83	0.5	0.1
6	2.01	0.5	0.1
7	2.19	0.5	0.1
8	1.83	0	0.1
9	1.83	1.0	0.1
10	1.83	1.5	0.1
11	1.83	0.5	0
12	1.83	0.5	0.05
13	1.83	0.5	0.15
14	1.83	0.5	0.20
15	1.83	0.5	0.25

Total base : 300 mL. Atmosphere : N<sub>2</sub>.

17,18 HPP - g - GMA  
 hollow PP  
 , 50  
 PE bag  
 E - beam 가 GMA  
 300 mL  
 Mohr's salt 가

Table 1

(degree of graft) (1)

$$\text{Degree of Graft (\%)} = \frac{W_g - W_o}{W_o} \times 100 \quad (1)$$

W<sub>o</sub> W<sub>g</sub>

19 HPP - g - GMA  
 150 mL 2

40 45  
 10 g 200 mL 24  
 , 10 wt%  
 70 80 24  
 HPP - g - GMA  
 CE Instrument (model :  
 EA 1110) CHN  
 ,  
 ,  
 20,21  
 HPP - g - GMA  
 24 가  
 (water uptake)  
 (2)

$$\text{Water Uptake (\%)} = \frac{W_w - W_g}{W_g} \times 100 \quad (2)$$

, W<sub>g</sub> W<sub>w</sub>

HPP - g - GMA

10% OH -  
 form  
 70  
 0.1 N 50 mL 가  
 24 , 20 mL  
 0.1 N  
 (3)

$$(\text{meq/g}) = \frac{(50 \times C_{\text{HCl}}) - 20(C_{\text{NaOH}} \times V_{\text{NaOH}})}{\% \times 100} \quad (3)$$

C<sub>HCl</sub> , C<sub>NaOH</sub>  
 V<sub>NaOH</sub>  
 mL

Mattson  
 FT - IR spectrometer 4000  
 400 cm<sup>-1</sup> 32 , resolution  
 4 cm<sup>-1</sup> KBr pellet

HPP - g - GMA

/KBr=1/200

Coulter(U.S.A.)      Omnisorp BET  
77 K      가

BET      (pore volume)  
(average pore diameter)  
morphology

ion sputter

ion current 5 mA      gold coating      JEOL  
JSM - 840A model      5000

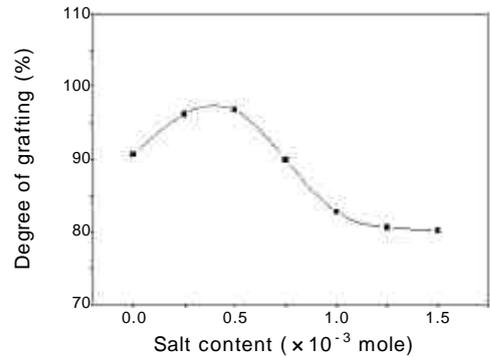


Figure 2. Relationship between degree of grafting of HPP - g - GMA copolymer and Mohr's salt contents.

E - beam

GMA      Mohr's salt

HPP - g - GMA

가 Figure 1

3

Figure 1      GMA

HPP - g - GMA

Figure 1

GMA      가      가

1.46 M      가

가      GMA      가 1.46 M

가      GMA가 hollow PP

GMA

가

Figure 2      Mohr's salt      가      HPP - g - GMA

Figure 2      , HPP - g - GMA

Mohr's salt      가       $0.5 \times 10^{-3}$  mole

가

가      Mohr's salt      가

GMA

가

Mohr's salt      가       $0.5 \times 10^{-3}$  mole

mole      hollow PP      GMA

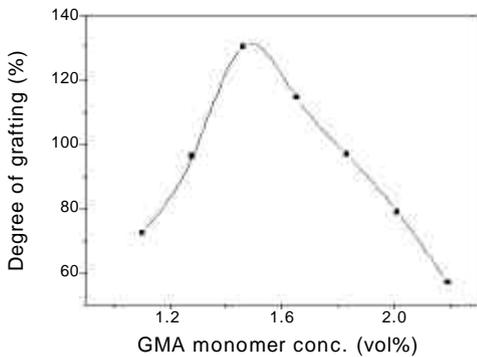


Figure 1. Relationship between degree of grafting of HPP - g - GMA copolymer and GMA monomer.

Mohr's salt      가

$0.5 \times 10^{-3}$  mole

가      90.6%

$0.5 \times 10^{-3}$  mole

가

Mohr's salt      가

가

Figure 3      가

Figure 3

가      가

가      ,      가      0.2 M

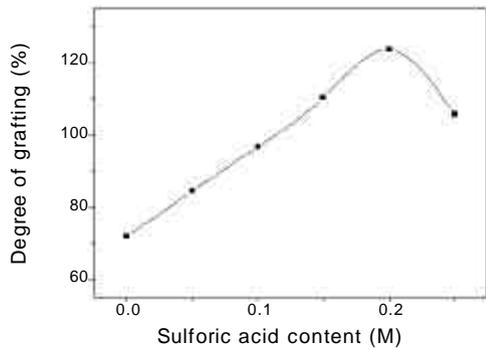


Figure 3. Effect of sulfuric acid concentration on the degree of grafting of HPP - g - GMA copolymer.

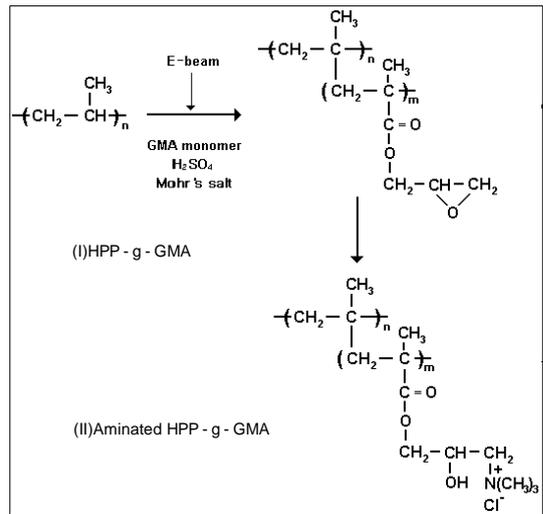


Figure 4. Synthetic scheme of aminated HPP - g - GMA ion - exchanger.

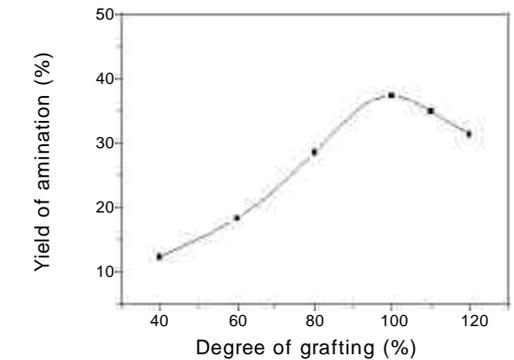
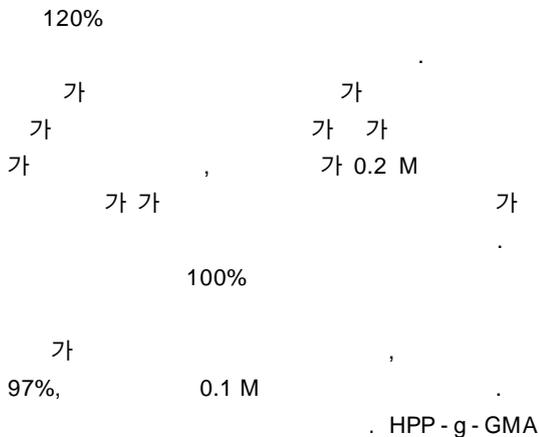
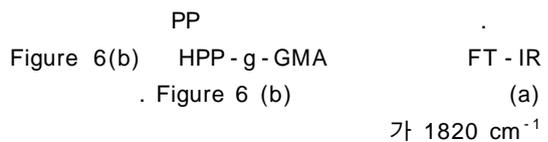
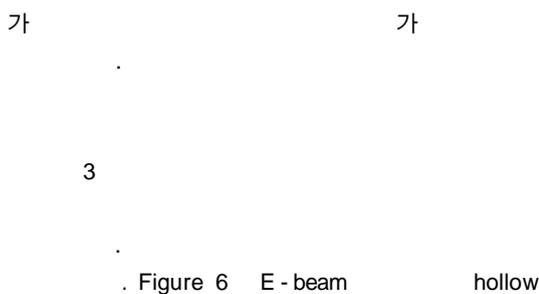
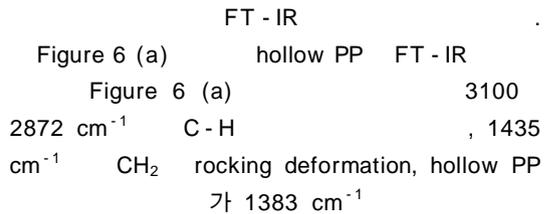
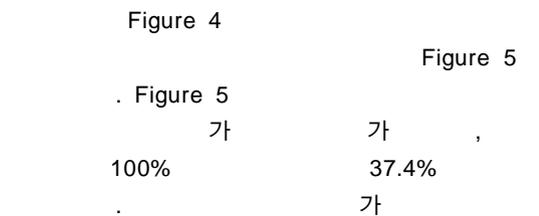
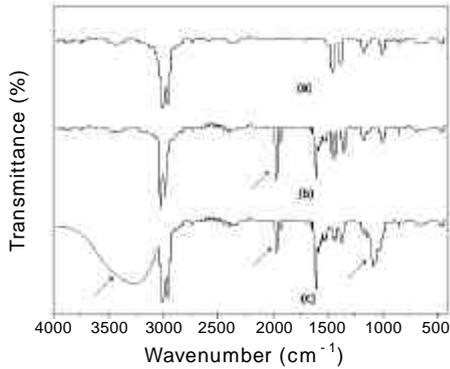


Figure 5. Relationship between yield of amination for HPP - g - GMA copolymer and degree of grafting.



PP



**Figure 6.** FT - IR spectra of HPP - g - GMA ion-exchangers. (a) hollow PP trunk polymer, (b) hollow PP - g - GMA, and (c) hollow APP - g - GMA.

1450  $\text{cm}^{-1}$  가  
 C=C 가 1650  
 HPP -  
 g - GMA 가  
 Figure 6 (c)

Figure 6 (c)  
 FT - IR  
 HPP - g - GMA  
 3450  $\text{cm}^{-1}$  -OH -C=N  
 가 1120  $\text{cm}^{-1}$  가 (b)

HPP - g - GMA가  
 Table 2  
 HPP - g - GMA  
 Table 2  
 가 가  
 가 가

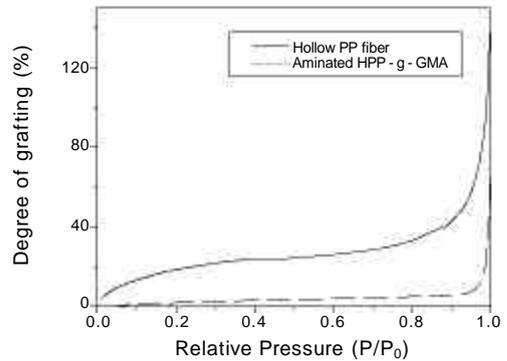
Table 2  
 가  
 H<sub>2</sub>O<sub>2</sub>  
 가  
 가

22

**Table 2. Swelling Ratio and Ion Exchange Capacity of Aminated Hollow PP-g-GMA**

		swelling ratio		ion exchange capacity	
yield of amination (%)	S.R. (g/g)	solvent	S.R. (g/g)	yield of amination (%)	IEC (meq/g)
12	3.21	methanol	4.12	12	0.65
18	3.67	ethanol	4.48	18	1.32
28	4.01	propanol	4.52	28	2.48
31	4.44	distilled water	5.01	31	2.96
37	5.01	H <sub>2</sub> O <sub>2</sub>	5.32	37	3.78

Temperature : 25



**Figure 7.** Relationship between relative pressure and volume adsorbed by N<sub>2</sub> gas.

Table 2

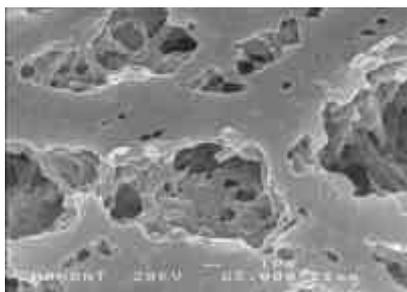
가 가  
 37% 3.78 meq/g  
 가 가  
 가 가  
 가  
 3.78 meq/g

BET Figure 7 hollow PP  
 HPP - g - GMA BET

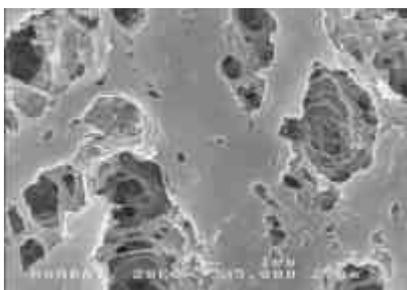
Figure 7 data

hollow PP  
 77.99 m<sup>2</sup>/g,

23 HPP - g -



(a) Hollow PP



(b) Aminated HPP - g - GMA

Figure 8. SEM photographs of Hollow PP fibrous ion - exchanger.

GMA 26 hollow PP 54.83 m<sup>2</sup>/g, 가  
 GMA 가 가  
 가 , 가

urokinase HPP - g - G MA urokinase  
 SEM . Figure 8 hollow PP, HPP - g - GMA morphology SEM . Figure 8

가

HPP - g - GMA urokinase 가

Hollow PP E - beam HPP - g - GMA

1. GMA 가 가 가 GMA 가 20% 130% 25% 100%가 Mohr's salt 가 0.5 × 10<sup>-3</sup> mole, 0.1 M 2. 가 가 100% 37.4%

3. HPP - g - GMA 가 가 37.4% 5.01 g/g HPP - g - GMA 3.78 meq/g

4. BET 26 , 54.83 m<sup>2</sup>/g hollow PP 가

5. SEM 가

urokinase 가 urokinase 가

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