Preparation of Tube Carbon Membrane Support by Apricot Shell

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Abstract: A tube carbon membrane support was prepared by carbonization of apricot shell with additive. The pore size distributions of support were characterized by bubble point method. Carbon particles were gained by heat-treatment of apricot shell and comminution. The carbon particles were molded to form tube green support. After drying and pyrolysis crack-free carbon membrane supports were gained. The results showed that the more adhesive was used, the smaller mean pore size of carbon membrane support became, and the smaller pure water flux was. The mean pore size of carbon membrane support and pure water flux decreased with particle size. The mean pore size and pure water flux can be adjusted by particle size and adhesive content.

Key words: carbon membrane support; carbonization; apricot shell; pore size distribution
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Membrane have been widely used in separation field since the last decade due to its excellent properties, such as room temperature operation, no phase changes, energy saving and high selectivity compared to traditional ways. It is regarded as a high new technology to solve energy source crisis and pollution[1]. Inorganic membrane has been arousing scientists' attention in the world because of its thermal and chemical stability and enough mechanical strength. Carbon membrane has not only the virtue of inorganic membrane mentioned above, but also uniform pore size distribution, high permeability and low cost[2-4]. An important consideration in preparing membrane is the thickness of the membrane because the permeation rate decreases with thickness[5]. Thus membrane is required to be ultrathin. Addition, the membrane must withstand the pressure drop across the membrane during operation. One approach to solve this problem is to prepare composite membrane by depositing a film on a porous support. The support provides adequate mechanical strength and is highly permeable in order to reduce resistant.

In this paper, carbon membrane supports are prepared by apricot shell. The effects of process variables on the structure and performance of carbon membrane support have been studied.

1 Experiments

1.1 Preparation of carbon membrane support

The pre-carbonized apricot shell was smashed in disintegrator and sieved. Phenol-formaldehyde resin, PVA and glycerol were used as additives.

The raw carbon particles are mixed with adhesive to make dough and then extruded to a tube green membrane support. The green support was carbonized at 800℃ for an hour under N_2 atmosphere.

1.2 Characterization of carbon membrane support

Bubble point method[6] is employed to test the pore size distribution of the carbon membrane support with isopropanol as wetting agent and N_2 as permeating gas. Pure water flux of membrane support was measured under the pressure of 0.1 MPa.

2 Results and discussion

2.1 Pore structure

Pore size distribution is the important characteristic of carbon membrane support. Employed additive content 6%, the effects of particle granularity on pore size distribution of carbon membrane support were in-

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vestigated. As shown in Fig. 1, the pore size distribution profile of carbon membrane support became sharp with the size of raw carbon particles decreasing. The mean pore diameter of carbon membrane support ranged from 0.45μm to 0.7μm, and increase with the size of carbon particles. Pores in the carbon membrane support are mainly from the stacking of carbon particles. The smaller carbon particles used, the smaller pores formed. One hand, spacing between particles diminished when fine particles stacked. On the other hand, some small particles can fill in the pores from other particles, which made stack more compact. Pore structure can be adjusted by changing size of carbon particles.

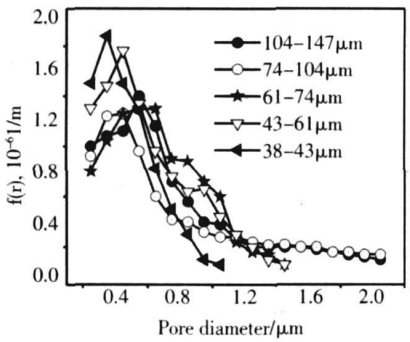

Fig. 1 Effects of particle size on pore size distribution of support

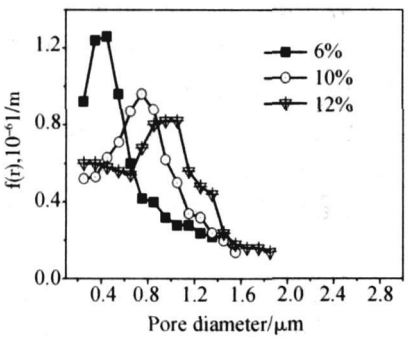

Fig. 2 Effect of additive content on pore size distribution of support

Figure 2 shows the effect of additive content on pore size distribution of carbon membrane support. The pore distribution became broad with additive content increasing. From Fig. 2 we can see the mean pore diameter increase with additives content. The result indicates that additive content plays an important role in preparing of carbon membrane support, which not only strengthens the carbon membrane support, but adjusts pore size distribution and mean pore diameter.

2.2 Pure water flux

Figure 3 shows the effects of particle size and additive content on the flux of pure water on carbon membrane support. The pure water flux decreases as particle size decrease. When the particle diameter changes from 43 ~ 61μm to 104 ~ 147μm, the water flux increases from 3260 to 5156 $L \cdot m^{-2} \cdot h^{-1}$. This is related with the porosity. Small particles result in a high stack density and low porosity and lead to a low flux. Although the adhesive can enhance the mechanic strength of carbon membrane support, it has a passive effect on the permeability of support. As shown in Fig. 3 (b), more adhesive results in low water flux. The reason is that adhesive changes into carbon during pyrolysis, which filled in the pores of support and decreased the flux. With 12% adhesive and particle diameter 104 ~ 147μm the pure water flux is as low as 467 $L \cdot m^{-2} \cdot h^{-1}$.

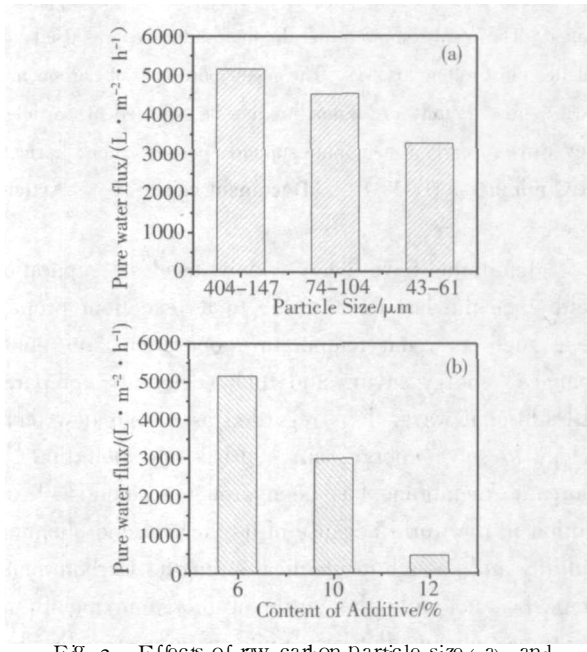

Fig. 3 Effects of raw carbon particle size (a) and adhesive (b) on pure water flux of membrane support

3 Conclusions

A tube carbon membrane support has been prepared by carbonization of apricot shell. The pore structure can be controlled by changing raw carbon particle size and adhesive amount. Big particles resulted carbon membrane support with large pores, wide pore size distribution and high water flux. With the increase of the adhesive content the pore size distribution become wide and the mean pore diameter is enlarged.

Acknowledgement

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曲杏壳制备炭膜支撑体

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摘　要：以杏壳为原料，通过碳化法制备了碳膜支撑体，利用泡压法表征了支撑体的孔径分布。对杏壳原料进行预碳化、粉碎、筛分得到碳粉，将碳粉和添加剂混匀挤出成型得到支撑体原膜，经干燥、碳化得到无缺陷碳膜支撑体。实验结果表明，粘结剂用量增加会导致支撑体平均孔径变小，纯水能量减小。随着原料颗粒的减小支撑体平均孔径减小，纯水能量下降。

关键词：碳膜支撑体；碳化；杏壳；孔径分布
中图分类号：TQ028.8

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融盐包裹法合成球形正极材料 $LiNi_{0.7}Co_{0.2}Al_{0.1}O_2$

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摘　要：以球形 $Ni(OH)_2$为核心原料，$Al(NO_3)_3\cdot 9H_2O$、$Co(NO_3)_2\cdot 6H_2O$和 $LiNO_3$为包裹原料，采用融盐包裹法在空气中煅烧合成了单相固溶体 $LiNi_{0.7}Co_{0.2}Al_{0.1}O_2$。用 XRD研究了合成产物的物相和结构，用 SEM研究了合成产物的形貌，用电池性能测试仪研究了合成产物的电化学性能。实验结果表明，合成产物具有 $\alpha-NaFeO_2$型层状有序结构、球状形貌和良好的电化学性能。

关键词：锂离子电池；球形正极材料；$LiNi_{0.7}Co_{0.2}Al_{0.1}O_2$；融盐包裹法
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