PRIMARY STUDY OF ETHYL CELLULOSE NANOFIBER FOR OXYGEN-ENRICHMENT MEMBRANE

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Ethyl cellulose (EC) has been widely regarded as a kind of water-insoluble materials with better membrane-forming ability, sustainable drug release, and gas-separation performance. The EC has the enhanced diffusivity selectivity for gas pairs of oxygen/nitrogen [1], and blend membranes of liquid crystal compound with EC have been widely used as the oxygen-enrichment membranes, which are usually prepared by a solution casting technique [2]. Recent study reveals that the oxygen flux increases as the thickness of thin dense layer decreases [3]. Nanotechnology makes it possible to make the membrane extremely thin [4, 5]. The EC nanofiber membrane for oxygen-enrichment is a promising new field in energy, materials science, and nanotechnology as well.

Nanofiber membranes possess fantastic physical properties, such as high surface reactivity [6] and excellent air permeability [7], and the bubbfil spinning is a perfect method to produce nanofiber [8-10].

Experiment

In this paper, EC particles are dissolved into alcohol/DMAc (9:1) at 25 °C. Other spinning conditions in bubbfil spinning process are used to adjust to control the fiber diameter. We adjust the collector distance from 5 cm to 30 cm with the fixed 20% concentration of solution and 25 kV applied voltage. The experiment is repeated for the concentration of 27% and 30%, respectively.

We observe that the fiber diameter increases when concentration of solution increases, this is because the thickness of bubble wall becomes larger for higher concentration of solution. Furthermore, we obtain the relationship between the diameter distribution and collector distance under different concentrations of solution, figs. 1(a)-(c).
Results and conclusion

Figure 1(a) shows that the number of fibers with diameter of 100 nm decreases with increase of the collector distance, while number of larger fiber with diameter of 200 nm increases. Figure 1(a) shows an EC nanofiber membrane with fiber diameter of 100 nm and 200 nm can be prepared, respectively, when the collector distance is 5 cm and 30 cm, tab. 1. We can obtain nanofiber membranes with fiber diameter varying from 100-600 nm by adjusting spinning conditions.

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References

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[3] Jiang, Q., et al., Oxygen Permeation Study and Improvement of Ba0.5Sr0.5Co0.8Fe0.2Ox Perovskite Ceramic Membranes, Journal of Membrane Science, 369 (2011), 1, pp. 174-181
[8] Li, Y., et al., Copper/PA66 Nanofibers by Bubbfil-Spinning, Thermal Science, 19 (2015), 4, pp. 1463-1465

Table 1. Spinning conditions for EC nanofiber membranes

<table>
<thead>
<tr>
<th>Diameter of nanofiber</th>
<th>Concentration of solution</th>
<th>Applied voltage</th>
<th>Collector distance</th>
</tr>
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<tbody>
<tr>
<td>100 nm</td>
<td>20%</td>
<td>25 kV</td>
<td>5 cm</td>
</tr>
<tr>
<td>200 nm</td>
<td>20%</td>
<td>25 kV</td>
<td>30 cm</td>
</tr>
<tr>
<td>300 nm</td>
<td>27%</td>
<td>25 kV</td>
<td>7.5 cm</td>
</tr>
<tr>
<td>400 nm</td>
<td>27%</td>
<td>25 kV</td>
<td>30 cm</td>
</tr>
<tr>
<td>500 nm</td>
<td>30%</td>
<td>25 kV</td>
<td>7.5 cm</td>
</tr>
<tr>
<td>600 nm</td>
<td>30%</td>
<td>25 kV</td>
<td>30 cm</td>
</tr>
</tbody>
</table>

Figure 1. The relationship between the diameter distribution and collector distance