Characterization of surface properties of polybutadiene rubber by inverse gas chromatography

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Abstract Inverse gas chromatography was applied to the characterization of the surface properties of polybutadiene rubber (PBR). Four n-alkanes C4, C8, C16 and C34-alkanes were chosen as the apolar probes to characterize the dispersive component of surface free energy. Dichloromethane, trichloromethane, acetone, ethyl acetate, diethylene and tetrahydrofuran were chosen as the polar probes to detect the Lewis acid-base parameters. It was found that the dispersive components of surface free energy were 47.07, 46.46, 45.85, 45.60 and 45.09 mJ/m² at 303, 313, 323, 333 and 343 K, respectively. The results showed that the surface free energy decreased linearly with the increase of temperature. The Lewis acidic number of PBR was 0.34 and the basic number was 1.77. The fact 1/Kb > 1 means that the surface of PBR was amphoteric with dominant basic character and the total ability of the surface to acid-base interactions was 2.11. The free energies of adsorption \( \Delta G^a \) and \( \Delta H^a \) by Lewis acid-base interaction were also figured out.

Key words inverse gas chromatography; IGC; acid-base parameters; surface free energy; polybutadiene rubber

\[ 1.07 \text{ mJ/m}^2 \]

探针分子计算得到聚合物的表面性质参数。在表征材料表面选择及界面优化等方面都具有重要的意义。当用非极性探针测试时,固定相与探针分子间常数,为该材料在共混及改性等方面的相关研究工作提供了参考。

实验部分

1 仪器与方法

1.1 PBR

n-C<sub>6</sub>H<sub>14</sub>, n-C<sub>12</sub>H<sub>26</sub>, n-C<sub>14</sub>H<sub>30</sub>, n-C<sub>16</sub>H<sub>34</sub>, n-C<sub>18</sub>H<sub>38</sub>, CH<sub>2</sub>Cl<sub>2</sub>, CHCl<sub>3</sub>, acetone, EtAc, ether, THF, 是参照气体(如甲烷)的常数，为室温。各分子探针的净保留体积是载气流速，为恒定的。当探针分子在固定相表面达到吸附平衡时，固定相与探针分子间常数，为该材料在共混及改性等方面的相关研究工作提供了参考。

1.2 酸碱性的吸附自由能变

不同温度下各分子探针的净保留体积的具体数值见表1。表1 颗粒物的净保留体积

<table>
<thead>
<tr>
<th>T/K</th>
<th>n-C&lt;sub&gt;6&lt;/sub&gt;</th>
<th>n-C&lt;sub&gt;12&lt;/sub&gt;</th>
<th>n-C&lt;sub&gt;14&lt;/sub&gt;</th>
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<th>Acetone</th>
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<tr>
<td>303</td>
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- \( \Delta G_s = R T \ln V_n + K \)
- \( \Delta G_s = N a W_s \)
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1. The plot of $RT\ln V_s$ versus $2N\bar{a}_i$ for $r_{i1/2}$ n-alkanes on a PBR column.

2. The plot of dispersive component of free energy versus temperature of PBR.

3. The plot of $RT\ln V_s$ versus $2N\bar{a}_i$ for probes column at 303 K.

4. The plot of $-\Delta H_s^\circ$ versus $DN/AN^*$ for polar probes on PBR column.

5. The plot of $-\Delta G_s^\circ$ versus $DN/AN^*$ for probes on PBR.

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