1. (bacteriorhodopsin, BR) *

```
<table>
<thead>
<tr>
<th>pH</th>
<th>1</th>
<th>2</th>
<th>pH</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
</table>
```

BR: 248, 216, N: 7, α: 1, C: 1

\[ \text{BR} \text{ pH} \text{ 7} \text{ α} \text{ 1} \text{ C} \text{ 1} \]

**Note**: The pH value is 7, and the α value is 1, with a C value of 1.

**Explanation**: The table above represents the pH values and experiment conditions for the bacteriorhodopsin samples. The pH values range from 1 to 2, with the corresponding BR samples.

**Details**: The BR samples were prepared at pH values of 1 and 2, with an α value of 1 and a C value of 1. This table provides a clear overview of the experimental conditions used for the bacteriorhodopsin samples.

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1. **Note**: This section contains additional experimental details on bacteriorhodopsin samples.

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**Keywords**: Bacteriorhodopsin, BR, pH, α, C, Experimental Conditions

**Authors**: This section includes the authors' names and affiliations.

**Corresponding Author**: The contact details for the corresponding author are provided, including their name, email, and phone number.

**Acknowledgments**: Acknowledgments are given for the support and funding provided for this research.

**References**: A list of references is included at the end of the document, with the corresponding page numbers provided.

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**Additional Information**: Any additional information or notes related to the experiment are included to provide a comprehensive understanding of the research.
所有实验操作若无特殊说明均在室温下进行。

2.1 紫外可见吸收光谱实验

在碱滴定过程中，特征吸收发生了蓝移。图中可以看到，随着X的升高，特征吸收峰的波长从红移到吸，吸收值也逐渐下降。当X将0.74时，特征吸收值进一步下降。值得注意的是在500～600 nm处开始出现了新的吸收峰，当X大于0.74的时候，在500～600 nm区域的特征峰完全消失，而在500～600 nm处出现了十分明显的吸收峰。说明此时的结构发生了巨大变化，视黄醛和位赖氨酸连接位置的希夫碱基被水解，视黄醛和位赖氨酸连接位置的希夫碱基被水解，从而释放出视黄醛分子。游离的视黄醛分子在500～600 nm处有特征吸收。

2.2 原子力显微镜实验

天然紫膜中性条件下原子力显微镜的实验结果已经有了多篇报道。我们的结果和他们的相同，可以清晰地看到平均直径在200 nm；呈椭圆或长圆型紫膜片层的整体形貌结构。图大尺度下的膜平面显得十分平整。在小尺度下的紫膜平面上，组成二维六角型晶格结构的三体单元清晰可见。图当缓冲液X上升为0.74时，紫膜的整体形貌以及精细结构都和图及图中相同的。当注入X为0.74的缓冲液并且平衡后发现，紫膜片层的结构发生了巨大的变化。从图中可以看到紫膜的整体形貌并没有改变，但膜上出现了新的结构变化。有的区域膜平面依旧平整，但更多的区域出现了凹凸不平的膜平面结构。取图中上部的区域进行观察。

2.3 原子力显微镜实验

当注入X为0.74的缓冲液并且平衡后发现，紫膜片层的结构发生了巨大的变化。从图中可以看到紫膜的整体形貌并没有改变，但膜上出现了新的结构变化。有的区域膜平面依旧平整，但更多的区域出现了凹凸不平的膜平面结构。取图中上部的区域进行观察。

2.4 原子力显微镜实验

当注入X为0.74的缓冲液并且平衡后发现，紫膜片层的结构发生了巨大的变化。从图中可以看到紫膜的整体形貌并没有改变，但膜上出现了新的结构变化。有的区域膜平面依旧平整，但更多的区域出现了凹凸不平的膜平面结构。取图中上部的区域进行观察。

关于原子力显微镜实验的详细内容，请参考文献[11,12]。
Fig. 5 The typical “Island” structure topography of purple membrane under pH 12.6
800 nm scale.

Fig. 6 The non-typical “Island” structure topography of purple membrane under pH 12.6
100 nm scale.
6 Metz G, Siebert F, Engelhard M. Asp85 is the only internal aspartic acid that gets protonated in the M intermediate and the purple-to-blue transition of Bacteriorhodopsin: A solid-state 13C CP-MAS NMR investigation. FEBS Lett, 1992, 303 (2~3): 237~241

The Direct Observation on The Surface Structure Change of Purple Membrane Induced by High pH Using Atom Force Microscope*

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Abstract The direct information of the surface structure change of purple membrane under high pH was obtained. The UV-VIS spectra showed that BR was totally denatured and lost its retinal under the pH 12.6. It was found by atom force microscope that the crystalline lattice of purple membrane was broken down at this pH. The typical and non-typical “Island” structures emerged as the BR molecules assemble irregularly in purple membrane.

Key words bacteriorhodopsin, purple membrane, pH, “Island” structure, atom force microscope

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