纳米孔技术

Nida Tabassum Khan

Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Takatu Campus, Airport Road, Quetta, Balochistan, Pakistan

【摘要】聚合物纳米孔对治疗公司大有裨益。它们提供有效的治疗和诊断特性。它们尺寸更小，成本效益更高。它们可用于治疗脑部疾病、眼部疾病以及其他目前无法治愈的疾病，未来可以通过聚合物纳米孔进行治疗。实验已在模型生物体上进行，结果可靠。除了干细胞之外，这项技术还可以彻底改变治疗公司。纳米孔技术展现出创新应用，具有灵活的信息吞吐量。该技术不仅应用于临床科学，还为环境清洁和保护提供了潜力。例如在水处理、污泥灭活过程、固体废物分离、过滤技术等中。纳米孔被描述为细胞或合成膜上的微小孔，用于在细胞内部区室之间以及细胞外环境和细胞本身之间识别和运输离子/分子。此外，DNA 测序中的纳米孔技术很好地体现了当今生化分子技术的进步。

【关键词】生物分子；聚合物；配体；生物传感；药物；半乳糖

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Nanopore technology

Nida Tabassum Khan

Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Takatu Campus, Airport Road, Quetta, Balochistan, Pakistan

【Abstract】Polymeric nanopores can be highly beneficial for therapeutic companies. They provide effective treatments and diagnostic characteristics. They are smaller in size, can be cost effective. They can be used to treat brain disorders, ocular diseases and other such diseases that are incurable now, can be treated with polymeric nanopores in future. The experiments are conducted on model organisms, showed reliable outcome. Other than stem cells, this technique can revolutionize the therapeutic companies. Nanopore technology displayed innovative applications with adaptable information throughput. This technology is not only utilized in clinical sciences but it also offers the potential for environmental clean-up and conservation such as in water treatment, sludge inactivation process, separation of solid wastes, in filtration techniques etc. Nanopores are described as tiny holes in cellular or synthetic membranes used for recognition and transport of ions/molecules between compartments within the cell, as well as between the extracellular environment and the cell itself. Furthermore, nanopore technology in DNA sequencing provides a good representation of present-day advancement in biochemical molecular techniques.

【Keywords】Biomolecules; Polymeric; Ligand; Biosensing; Pharmaceuticals; Galactose

1 简介

纳米孔存在于自然界中，其直径约为 1 纳米[1]。这些孔隙是通过工程设计的，其制造基于生物结构[2]。这些纳米孔由合成材料制成，例如氮化硅、氧化硅、硅和聚合物薄膜[3,4]。纳米孔是检测和分析单个生物分子及其运输机制的重要工具，同样，纳米孔也有着特殊的应用，如生物传感、药物输送等[5,6]。聚合物囊泡具有独特的性质，有望成为纳米药物的重要载体[7]。此外，由于其独特的特性，例如可调的几何形状、耐溶剂环境和选择性，它们成为纳米生物技术的理想工具[8]。

1.1 聚合物纳米孔的制备

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通过纳米压印光刻(NIL)制造聚合物纳米孔是一种简单且经济有效的方法，其中 3μm 直径的微孔被缩小至约 300nm[9]。虽然将孔径控制在 100nm 是一种繁琐的方法，因为孔径较大，且收缩速率很快，在 5 分钟内可达 130-288nm/min，具体取决于施加的压力[10,11]。

1.2 聚合物囊泡的制备

聚合物囊泡是一种有趣的聚合物纳米孔类型。其尺寸范围根据其应用而有所不同，包括用于药物递送的载体[12]，以及用于治疗和诊断[13]。聚合物囊泡的主要目标是通过有效地靶向、结合和粘附在不同细胞表面，在不丧失其正常功能的情况下，实现疾病的治疗和诊断。它们既可以治疗[14,15]，也可以诊断。

1.3 纳米孔中使用的聚合物

聚合物纳米孔旨在将药物输送至受感染的细胞或器官，而不会影响健康的细胞和器官[16]。聚合物纳米孔用于携带抗体，例如曲妥珠单抗、吉妥珠单抗和贝伐单抗，这些抗体是针对多种癌症的有效药物[17,18]。另一种是肽，它比抗体更小[19]，而且由于它是不同癌细胞受体的特异性配体，因此更容易控制[20]。碳水化合物已被证明是另一种有效的聚合物，可以设计成纳米颗粒[21]。同样，半乳糖和甘露糖可以识别仅存在于肝细胞上的糖蛋白受体，从而作为有效的肝脏靶向配体[22]。

1.4 聚合物纳米孔在生物医学领域的应用

在现代生物医学领域，聚合物囊泡是一种先进的纳米载体系统。它们在靶向药物递送、细胞靶向、细胞成像和治疗诊断方面有着显著的应用[23,24]。

（1）靶向药物输送

聚合物纳米孔的目标是开发或设计一种不影响正常细胞的药物递送方式[25]。靶向药物递送是通过对纳米载体进行功能化，使其与针对器官、组织或细胞的不同靶向配体结合来实现的[26]。这种药物递送方法非常有效，因为副作用极小[27]。靶向药物递送既可以用于疾病的诊断，也可以用于疾病的治疗[28]。例如，血脑屏障阻碍大分子进入，导致脑部疾病的治疗变得困难。借助纳米孔，药物可以轻松地被输送到大脑的缺陷区域[29]。

（2）诊断应用

治疗诊断学是开发能够同时诊断和治疗疾病的多功能纳米载体[30]。成像技术用于诊断和表征疾病细胞的不同表型[31]。另一方面，靶向递送治疗剂会破坏疾病细胞的所有不同表型[32]。

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