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Nanopore Technology

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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. Introduction

Nanopores exist in nature, and nanopores are one nm or so in diameter [1]. The pores are engineered, and their fabrication is based on biological structures [2]. These nanopores created from synthetic materials; like, silicon nitride, silicon oxide, silicon, and polymer films [3, 4]. Nanopores are an essential tool to detect and analyze single biomolecules and their transport mechanism; likewise, nanopores have exceptional applications, like, biosensing, drug delivery and so on [5, 6]. Polymersomes have unique characters; they are appealing as a vital class of vehicles for nano pharmaceuticals [7]. In addition, due to their unique characteristics, like, tunable geometry, resistance to solvent environment and selective nature, they are suitable tools for Nanobiotechnology [8].

1.1 Fabrication of Polymeric Nanopores

Fabrication of polymeric nanopores by nanoimprint lithography (NIL) isa simple and cost-effective method in which 3 μm diameter micropores are reduced to approximately 300 nm [9]. Though it is a tiresome method to manage the pore size up to 100 nm because the pore size is larger and the shrinking rate is fast as 130-288 nm/min in 5 min depending on applied pressure [10, 11].

1.2 Fabrication of Polymersomes

Polymersomes are an interesting type of polymeric nanopores. The size range varies based on their application which includes vehicle for drug delivery [12], for both treatment and diagnostic purposes [13]. The main goal of polymersomes is to achieve treatment of disease as well as diagnosis by targeting, binding, and adhering on the surface of different cells effectively, without loss of their proper function, they treat as well as diagnose [14, 15].

1.3 Polymers used in Nanopores

Polymeric nanopores are designed to deliver drugs to infected cells or organs without affecting the healthy cells and organs [16]. Polymeric nanopores are used to carry antibodies, such as, trastuzumab, gemtuzumab and bevacizumab, which are effective drugs against several types of cancers [17, 18]. Other one is peptide which is smaller comparative to antibodies [19] and it is easier to control as it is specific ligand to receptors on the different cancer cells [20]. Carbohydrates are proved to be another effective polymer that can be designed into nanoparticles [21]. Likewise, galactose and mannose can recognize the glycoprotein receptor present only on hepatocytes and thereby serve as effective liver targeting ligands [22].

1.4 Applications of Polymeric Nanopores in Biomedical Field

In advanced era, polymersomes are an advanced nanocarrier systems in the field of biomedical science. They have prominent applications in targeted drug delivery, cellular targeting, cell imaging and theragnostic [23, 24].

1) Targeted Drug Delivery

The goal of polymeric nanopores is to develop or design a drug delivery that does not affect the normal cells [25]. Targeted drug delivery is achieved by functionalization of nanocarriers with different targeting ligands, which are specific to the organ, tissues, or cells [26]. This drug delivery method is effective as it has minimum side effects [27]. Targeted drug delivery can be used both for diagnostics and treatment of the disease [28]. For instance, blood brain barrier that does not allow large molecules to enter, making the brain diseases' treatment difficult. With the help of nanopores, the drugs can easily be introduced to defected areas of the brain [29].

2) Theragnostic Applications

Theragnostic is the development of multifunctional nanocarrier that can diagnose and treat the disease simultaneously [30]. Imaging is used to diagnose and characterize the different phenotypes of disease cells [31]. On the other hand, targeted delivery of therapeutic agents destroys all the different phenotypes of disease cells [32].

2. Conclusion

Thus, nanopore technology has revolutionized the field of medical diagnostics and therapeutics.

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