



Mini Review

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A Brief Note of Nitrocellulose Membrane Applied for Biomedical Immobilization and Diagnosis

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Introduction

Nitrocellulose (NC), obtained after nitration reaction, has a similar configuration with cellulose, so it is also named as cellulose nitrate [1]. As a fibre-like energetic material, NC is not limited in its original form and applications. One secondary product of NC is the NC membrane, which was described as the paper-like and microporous matrix [2]. The excellent signal-to-noise ratio [3], biocompatibility and stability of porous NC membrane substrates enable many relative biomedical applications, such as filtering [4,5], molecular immobilization and immuno-diagnosis. In this article, we are focused on these biomedical achievements of NC membrane.

Above all, the surface immobilization or modification allowed multifunctional applications of NC membrane. The approach for surface immobilization of NC membrane was various in previous studies. Firstly, some liquid substances could be directly adsorbed on NC membrane. For example, when NC membrane was adsorbed by [¹⁴C]tyrosinated tubulin, it could be used for the activity test of tubulin carboxypeptidase [6]. Then, Peng Zhang et al. [7] also prepared a circulating tumor cell capture substrate by this self-assemble phenomenon [7]. Secondly, the immobilization could be achieved with an "extra-assistance". The assistance could be acted from a binding media, such as gelatin. Because fibronectin has excellent gelatin binding performance, gelatin was successfully used as the media between NC membrane and fibronectin [8]. Despite the mentioned chemical media, external electric field could also promote the adsorption of NC membrane. As powered by electro kinetic phenomenon, a compact layer of protein was found to be adsorbed on the NC membrane [9].

As for the diagnosis applications, dot-ELISA is an important immunoassay method basing on NC membrane. As early as 1995, Kwabena M. Bosompem et al. [10] reported a destaining protocol for NC membrane by using hydrogen peroxide, which overcame the confusion caused by heavy staining on NC membrane [10]. In recent years, dot-ELISA has been proved to combine advantages of ELISA and EITB on the diagnosis of human trichinellosis [11]. Also, for serodiagnosis of avian reovirus and human strongyloidiasis, dot-ELISA was suggested as an effective alternative to ELISA [12,13]. Other animal, like cattle, could be diagnosed by DotELISA with low cost as well [14].

Besides, another diagnosis approach was about the combination of NC membrane with specified "detectors". South Korean scientists conjugated the magnetic beads with the antibody, then, this "bio-sensor" on NC membrane successfully detected the influenza A viruses [15]. Similarly, another research group from the same country detected the C-reactive protein by MCLW sensor, which was previously coated on NC membrane [16]. As the carrier to biosensors, NC membrane was concerned as well. American researchers even published a NC membrane immunoassay platform, which has different reagents to capture and control the detected biomolecules [17].

In nature, various bacteria and virus not only threaten human and animals but also plants. The ecosystem of the earth has its own balancing mechanism, but our demand of agricultural products is rising rapidly in the 21st century. Therefore, the diagnosis of botanic virus is critical as well. As a cheap solid matrix, nitro

pure NC membrane was applied for the detection of RNA from cucumoviruses and potyviruses [18].

No matter how the bio-diagnosis develops, efficiency and accuracy are always what we are seeking. On this occasion, the multiple diagnosis method will be necessary in the future. In order to further improve the efficiency of detection, the antibody array, which could detect multiple plant pathogens simultaneously, was developed on NC membrane substrate [19]. In 2018, another group reported the study on simultaneous detection of mycotoxins [20]. Next, the point-of-care detection technique will be another critical developing trend. It was believed that the hydrophobic coating on NC membrane would promote the binding of complexes, meanwhile, their sensitivity was higher than before [21]. To achieve the diagnostics with the point of care, Caitlin E. Anderson et al developed a novel 2-dimensional paper network which contained the NC membrane [22].

Prospect

It seems that investigations of NC membrane for biomedical application have been lasted for decades. It is also reasonable to believe that those studies will be continues, against the demand of global public health. The case of wastewater analysis by NC membrane in Eastern Cape South Africa [23] demonstrates that parts of current eco-protection techniques are still far from success. Since January 2020, human beings are now suffering Novel Coronavirus, 2019-nCoV. Will NC membrane contribute the detection of Novel Coronavirus? To my knowledge, it might be a considerable question. According to all references mentioned above, personally I think NC membrane might be useful in following aspects:

A. The filtering of water source

The microporous structure will help us confirm if 2019-nCoV has polluted the water source of the citizen.

B. The assemble of bio-sensor for 2019-nCoV.

In many countries, a large number of patients or potential patients are waiting to be diagnosed if they have been infected the 2019-nCoV. Therefore, more rapid diagnosis methods for COVID-2019 are urgently needed.

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