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Ultra-low noise measurements of nanopore-based single molecular detection

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Abstract: Nanopore is an ultra-sensitive electrochemical technique for single molecular detection in confined space. To suppress the noise in detection of the weak current of nanopore, we investigated the influence of membrane capacitance and applied voltage on the noise of the current signal by model analysis, simulation and experiment. The obtained results demonstrated that membrane capacitance affects the noise by amplifying the noise of the applied voltage. Therefore, suppression of applied voltage noise is an efficient approach for reducing the noise in nanopore detection. Here, we developed an ultra-low noise instrument system for detecting the single molecule signal in nanopores. As demonstrated by nanopore experiments, the p-p noise of the developed system during the recording is reduced to 3.26 pA using the filter of 5 kHz. Therefore, the developed system could be applied in highly sensitive nanopore detection.

Keywords: Nanopore; Membrane capacitance; Current amplifier; Signal Amplifier and recording; High current resolution

1 Introduction

Nanopore technique is a powerful tool for single molecule detection showing the advantages of high throughput, low cost, label-free and no vacuum environment required [1-3]. It could be utilized for the recognition of molecules such as DNA [4, 5], RNA [6], proteins [7] and peptides [8] and for studies of molecular interactions [9] and molecular dynamics [10]. Therefore, nanopore technique has wide applications in the field of biology and clinical diagnosis