**Factors Affecting the Protein Detection Efficiency of a New Microchannel Electrophoresis Device**

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Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) has been widely used for protein identification because of its many advantages. There are reports on separating proteins using the micro-channel-based structure [1]. These devices often require a high electric voltage to operate and a complicated labeling and detection procedure [2]. Recently, authors have successfully demonstrated a new type of microchannel electrophoresis device that simultaneously separated and identified individual proteins from a mixture [3,4]. The principle of this device is similar but different from that of a conventional electrophoresis. Proteins are separated due to the screen effect of the gel in the channel. However, individual proteins are transported through the channel and subsequently adsorbed on the surface of the detection electrode. A drastic drop of the current occurs when a protein arrives the surface of the detection electrode. Each protein corresponds to a specific current drop time. Proteins of different molecular weights in the same solution were identified with this new device. Therefore, this is a simple but effective protein analysis method. In this paper, authors studied factors that affecting the detection efficiency of this device.

The microchannel devices were fabricated with the same method as described in refs. 3 and 4, except the channel was passivated with a RF magnetron sputter deposited $SiO_x$. The channel depth was varied between 10 and 30 μm. The detection electrode area was varied between 0.01125 and 0.045 $cm^2$. Three proteins, i.e., ovalbumin (45kDa), carbonic anhydrase (29kDa) and α-lactalbumin (14.2kDa), were tested. The total protein concentrations were 650, 1300 and 1950 μg/ml.

Figure 1 shows a cross-sectional view of the microchannel structure and a simple resistance model. The total resistance ($R_{total}$) is composed of $R_1$ (contact resistance between the feed electrode and the feed reservoir solution), $R_2$ (resistance of the solution in the feed reservoir), $R_3$ (resistance of the channel region), $R_4$ (resistance of the solution in the detection reservoir) and $R_5$ (contact resistance between the detection electrode and the detection reservoir solution). The $R_{total}$ is a function of varies parts of the device, the gel concentration, and the feed and detection reservoir solutions. Figure 2 shows two examples of the $R_3$ (the channel depth) and $R_5$ (the detection electrode size) effects on $R_{total}$.

Figure 3(a) shows that three proteins were separated within 20 min using this kind of device, which has a channel depth of 20 μm, channel length of 0.5 cm, and detection electrode area of 0.045 $cm^2$. It was operated at an electric field of 20 V/cm. Each protein is clearly identified from the large and sharp peak. Figure 3(b) shows the same proteins separated and identified with a different device configuration, i.e., the channel depth of 30 μm and the detection electrode area of 0.03375 $cm^2$. It is clear that the detection efficiency is enhanced with the increase of the channel depth and the decrease of the electrode area.

Other factors influencing the device performance will also be discussed in this paper.

## REFERENCE

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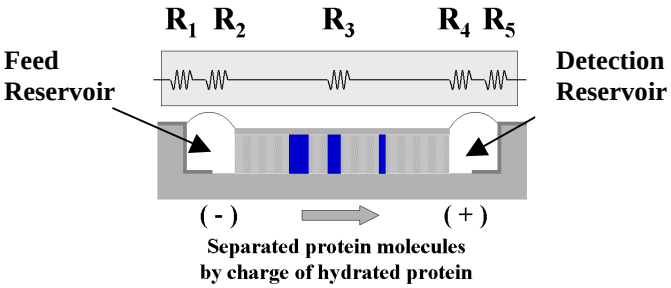


Figure 1 Schematic diagram of electrophoresis in microchannel and its resistance model

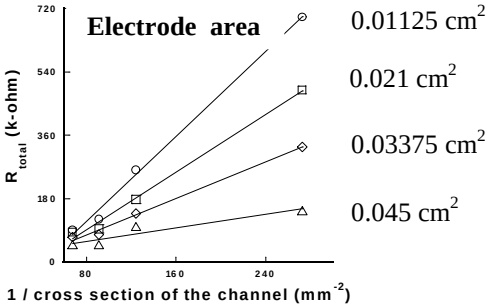


Figure 2 $R_{total}$ changes with different channel cross-section area and detection electrode size

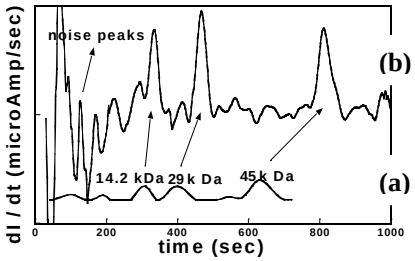


Figure 3 Curves of current change rate vs. time of two devices of different dimensions