

Preface

This book introduces some novel gigaseal formation approaches in patch clamping using micro-/nanotechnology. Patch clamping is a technique to measure currents passing through ion channels in a cell membrane. It was first introduced by Neher and Sakmann in 1976 and was honored with the Nobel Prize in Physiology or Medicine in 1991. Although this technique has greatly expanded our understanding of the fundamentals of cells, the nature of the technique makes it laborious, time-consuming, and very low in throughput, which does not satisfy the needs of pharmaceutical companies. Patch clamping is totally dependent on the formation of a high-resistance seal, which is as high as giga Ohms and thus known as gigaseal, between cell membrane and patching site. Although the mechanism of gigaseal formation is not yet fully understood, the most important factors in seal formation are known. The introduction of planar patch clamping has revolutionized the technique. The new approach has made use of the advantages of microfabrication processes, microfluidics, and nanotechnology to facilitate patch clamping. Numerous designs have been developed all over the world. While these efforts were successful in developing less laborious and higher throughput systems, the low seal resistances of planar patch clamping systems have so far prevented them from becoming an absolute alternative to the conventional technique. In fact the superior data quality of conventional pipette-based patch clamping recordings has made this approach the gold standard for ion channel studies. It seems that before being able to develop high-throughput systems successful in forming high-resistance seals, in-depth studies on the mechanism of gigaseal formation are needed. In this book, we share with readers our recent practice in acquiring gigaseal formation using micro-pipettes. Nanotechnology has been used to make this possible.

Gigaseal Formation in Patch Clamping

With Applications of Nanotechnology

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