Clemson University Research Foundation

Low Cost Identification of Small Molecules and Molecular Subunits (2015-045)

Detects and identifies molecular units as they translocate a nanopore

Market Overview

This approach to molecular analysis and genome sequencing consists of a way to identify small molecules or molecular subunits by taking advantage of changes in the electrical double layer chemical potential and current as well as mobility of the analyte within the nanopore. The global markets for personalized medicine and genomic sequencing are expected to increase in the coming years due to technological and research advancements. The genome sequencing market alone is expected to reach a value of $20 billion by 2020. Current technologies only use ionic current signal to identify molecules; however, this method has not proved practical due to the use of modern nanopores. Clemson University researchers instead developed a device that utilizes the changes in electrical double layer chemical potential in combination with current changes and mobility rates of the analyte within the nanopores. By combining all three of these sensing mechanisms, this nanopore device can detect and identify molecules moving through the nanopore because molecules of various sizes and charges produce different electric potential signals. The success of this sensing approach is a key advancement in the emerging field of personalized medicine and predictive diagnostics.

Application

Nanotechnology, Biotechnology; Genomic sequencing

Stage of Development

Proof-of-concept prototyping

Advantages

- Has capability of molecular and sub-molecular resolution, reducing the amount of sample needed for analysis
- Is reusable for multiple samples without noticeable degradation in performance, providing a cost effective means of identifying molecules
- Enables stable and repeatable signal transduction, resulting in a device that offers better reliability than similar technologies

Technical Summary

This nanopore device provides a way to identify small molecules by utilizing changes in electrical double layer capacitance and ionic current as well as the mobility rate of the analyte passing through the nanopores. This is done by driving an electrolyte solution containing identifiable molecules through a nanopore. Then, an electrical potential associated with the constant electrical current is applied to the nanopore and the ionic current through the nanopore is measured. Transient changes to the electrical potential, ionic current, and signal rate as the molecules move through the nanopore are detected and measured relative to a determined baseline. The magnitude of the electrical potential signal is correlated to the charge and size of the molecular analytes, allowing classification of different analytes. This device is reusable for multiple samples and because of the stable and repeatable signal transduction, it offers better reliability than similar approaches.

App Type	Country	Serial No.	Patent No.	CURF Ref. Number	Inventors
Provisional	United States	62/448,166	NA	2015-045	Samuel Bearden, Guigen Zhang

About the Inventor

Dr. Guigen Zhang is a Professor of Bioengineering and Electrical and Computer Engineering at Clemson University. He earned his Ph.D. in Bioengineering from Clemson University and his B.S./M.S. in Mechanical Engineering from Tongji University. Prior to joining Clemson faculty, Dr. Guigen was an Associate Professor at the University of Georgia. He currently serves on the editorial board of the Journal of Biological Engineering and is an education editor for the Biomaterials Forum. His research interests focus on micro/nano structures for electron-transfer devices, electrochemical processes of nanostructure electrodes, biomechanics and biomaterials, nanostructure influences tissues and cellular engineering, and modeling of multidisciplinary phenomena.

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