Bioprocessing technologies for enabling biomarker detection

Abstract

Physicians and patients rely on in vitro diagnostic tests to make most medical decisions. In addition to the sensitive detection technologies, bioprocessing is an equally important component for biomarker detection by effectively isolating the specific target analytes. To enable rapid and sensitive biomarker detection, we developed temperature-responsive polymer reagents (e.g., polymer-antibody conjugates) that are water soluble at room temperature and rapidly transition to hydrophobic when the solution temperature is above the polymer's lower critical solution temperature (LCST), ~32°C. This reversible temperature-responsiveness allows the water-soluble reagents diffuse rapidly to give real-time binding kinetics, and then transition to more hydrophobic reagents that form aggregates or interact with surfaces to promote rapid separation via heating. Other than the polymeric reagents, we also developed devices that employ osmosis to statically and spontaneously concentrates urinary biomarkers. In this presentation, I will show microfluid assays that utilize the polymer-antibody conjugates for detecting disease biomarkers (e.g., prostate specific antigen) in 30 minutes with more sensitive detection limit than ELISA. I will also share exosome analyses via a temperature-responsive binary reagent system with anti-tetraspanin antibodies, which selectively isolated exosomes within ≤1.5 hours, a much faster approach than the microbeads' 2-day process. I will also present our recent work using the osmotic processer to concentrate protein markers nearly 100-fold, which was directed assayed using a lateral flow test.

Bio

James Lai currently serves as a Research Associate Professor in the Department of Bioengineering at the University of Washington. He received a Ph.D. in Chemical Engineering from the New York University Tandon School of Engineering (formerly Polytechnic University) with emphasis in the field of nanomaterials. He also holds a bachelor's degree in Chemical Engineering from the University of Minnesota. Dr. Lai's research focuses on developing novel nanomaterials and reagents for bioprocessing to enhance biomarker detection/clinical assays, to improve therapeutic biologics manufacturing, and to enable life science research. He has extensive experience in biomedical research, which is intrinsically multidisciplinary in nature, requiring contributions from experts in various fields. His research has been supported by National Institute of Health, Coulter Foundation, etc. Dr. Lai is also passionate about translating the technologies developed in research laboratories to potential clinical applications that benefit the standard of care received by patients. He is a co-founder of Nexgenia, Inc., a biotech startup that aims to translate the polymer technologies from his group for in vitro diagnostics, immunotherapy, etc. In 2017, he was selected as a fellow of Leaders in Future Trends, supported by Taiwan Ministry of Science and Technology to explore technology development, commercialization, and research collaboration in Taiwan. Dr. Lai will join the Department of Materials Science and Engineering at the National Taiwan University of Science and Technology as an Associate Professor in 2022.