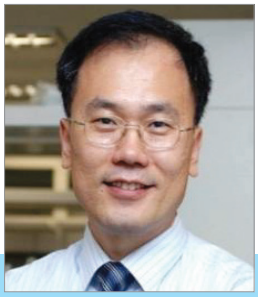


Park, Je-Kyun
Professor

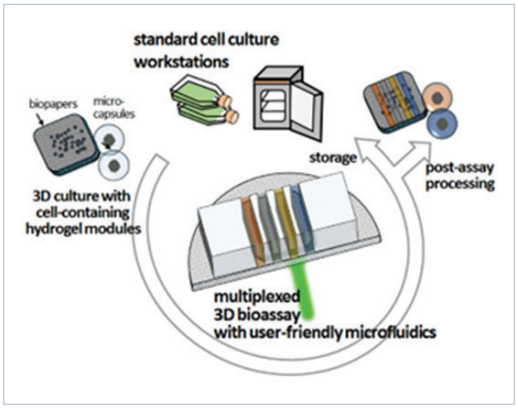
PH.D., KAIST [1992]
jekyun@kaist.ac.kr
http//nanobio.kaist.ac.kr

President of the Korean BioChip Society

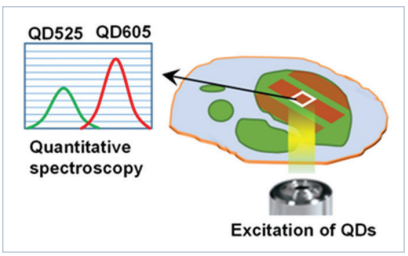
NanoBiotech Laboratory

Recent progress of lab-on-a-chip technology is challenging for the development of nanobiotechnology and integrative bioengineering. Particularly, micro/nano fluidics has been a key technology for the realization of micro total analysis systems (μTAS) or lab-on-a-chip as well as the next generation bio-tools for drug discovery, diagnostics, and tissue engineering. This research area covers the design and development of miniaturized devices that manipulate liquid samples at nanoliter volumes, allowing biological assays to be integrated and accomplished on a small scale with minimum time and cost. Prof. Park's research focuses on the development of a nanobiosensor, microfluidic device and lab-on-a-chip as a new platform for biological sample processing, separation, and detection, including optoelectrofluidics, hydrophoretic separation, magnetophoretic assay, and cell-based assay. From June 2008, his laboratory has been selected to receive a National Leading Research Laboratory Program grant through the National Research Foundation of Korea funded by the Ministry of Science, ICT and Future Planning

3D microfluidic bioassays: Recent progress in the development and application of hydrogel-incorporated 3D cell culture and microfluidic bioassays were reviewed [1]. Particularly, 3D bioassay platforms with cell-containing hydrogel modules offer the promise of significant advantages over existing hydrogel-incorporated microfluidic devices, particularly long-term cell maintenance, co-culture of multiple cell types, and organization of cellular arrangements that can duplicate those in vivo. We anticipate that the modular and user-friendly format interfaced with existing laboratory infrastructure will help address several clinical questions in ways that extend well beyond the current 2D cell-culture systems.

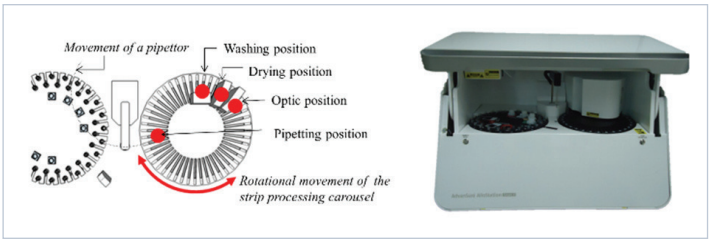


Quantum-dot-based microfluidic immunohistochemistry: An automated multiple biomarker measurement method for tissue from cancer patients was developed using quantum dot (QD)-based protein detection combined with reference-based

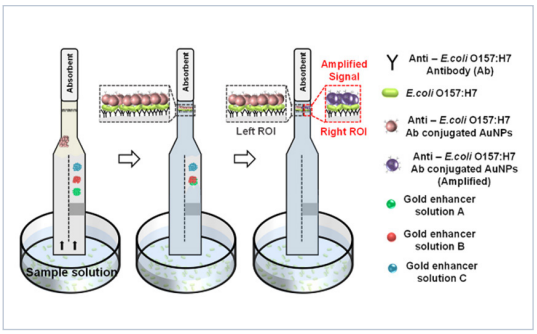


protein quantification and autofluorescence (AF) removal [2]. For the automated measurement of biomarkers, a cytokeratin-based biomarker normalization method was used to measure the averaged expression of proteins. A novel AF-removal algorithm was also proposed and demonstrated to normalize the reference AF spectra reconstructed from unknown AF spectra based on random sampling. This approach ensures accurate removal of the background signal from the original protein signals, which leads to more accurate quantification of QD-labeled biomarkers.

Multiple detection of allergen-specific immunoglobulin E: A multiple allergen-specific IgE test is an efficient way to know a patient's IgE profile. We reported a new clinical laboratory analyzer, which is a fully automated system for multiple allergy tests. For efficient automation of immunoblot procedures, a novel tilting carousel technology was incorporated [3]. In this technology, the strip-processing carousel simply rotates in a tilting state, and other sampling, washing, drying, and reading modules are fixed at the designated positions and do not need three-axis movements. The rotational movement and tilting state of the carousel can locate the immunoblot strips to the required positions, give conditions to shake the reagent vessels, and facilitate the aspiration of wasted reagents. Up to 1860 allergen-specific IgEs can be measured in 3 h and 45 min without manual interruption from sample addition to the final measurement.



Paper fluidic one-step detection of *Escherichia coli*: We developed a pressurized paper-based E. coli O157:H7 detection platform that enables signal enhancement operated by one-step dipping method [4]. After characterization of delayed flow and formation of channel partition in a pressurized paper-based microfluidic device, we detected *E. coli* O157:H7 quantitatively. We expect this platform to be utilized in on-site detection for decreasing limit of detection by increasing sensitivity caused by signal enhancement. Additionally, untrained people are expected to easily use this platform.



Key Achievements

1. M. G. Lee, J. H. Shin, C. Y. Bae, S. Choi, **J.-K. Park**, "Label-free cancer cell separation from human whole blood using inertial microfluidics at low shear stress," Analytical Chemistry, 85, 6213–6218, 2013.
2. F. Shen, H. Hwang, Y. K. Hahn, **J.-K. Park**, "Label-free cell separation using a tunable magnetophoretic repulsion force," Analytical Chemistry, 84, 3075-3081, 2012.
3. H. Hwang, **J.-K. Park**, "Optoelectrofluidic platforms for chemistry and biology," Lab on a Chip, 11, 33-47, 2011.
4. M. S. Kim, T. Kim, S.-Y. Kong, S. Kwon, C. Y. Bae, J. Choi, C. H. Kim, E. S. Lee, **J.-K. Park**, "Breast cancer diagnosis using a microfluidic multiplexed immunohistochemistry platform," PLoS One, 5, e10441, 2010.
5. J. H. Kang, S. Choi, W. Lee, **J.-K. Park**, "Isomagnetophoresis to discriminate subtle difference in magnetic susceptibility," Journal of the American Chemical Society, 130, 396-397, 2008.

Achievement In This Year

1. D.-H. Lee, C. Y. Bae, S. Kwon, **J.-K. Park**, "User-friendly 3D bioassays with cell-containing hydrogel modules: narrowing the gap between the microfluidic bioassays and the clinical end-user's needs," Lab on a Chip, 15, 2379-2387, 2015.
2. S. Kwon, C. H. Cho, E. S. Lee, **J.-K. Park**, "Automated measurement of multiple cancer biomarkers using quantum-dot-based microfluidic immunohistochemistry," Analytical Chemistry, 87, 4177-4183, 2015.
3. J. H. Oh, M. K. Park, S. W. Kim, **J.-K. Park**, "A fully automated analyzer for multiple detection of allergen-specific immunoglobulin E," Analytical Methods, 7, 8889-8895, 2015.
4. J. Park, J. H. Shin, **J.-K. Park**, "One-step detection of *Escherichia coli* O157:H7 by signal enhancement in a pressurized paper-based microfluidic device," Proceedings of μTAS 2015 Conference, Gyeongju, KOREA, pp. 278-280, 2015.