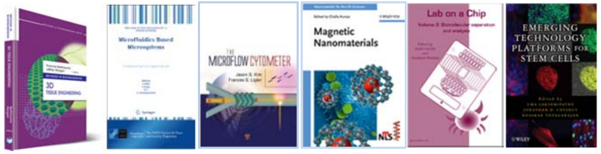
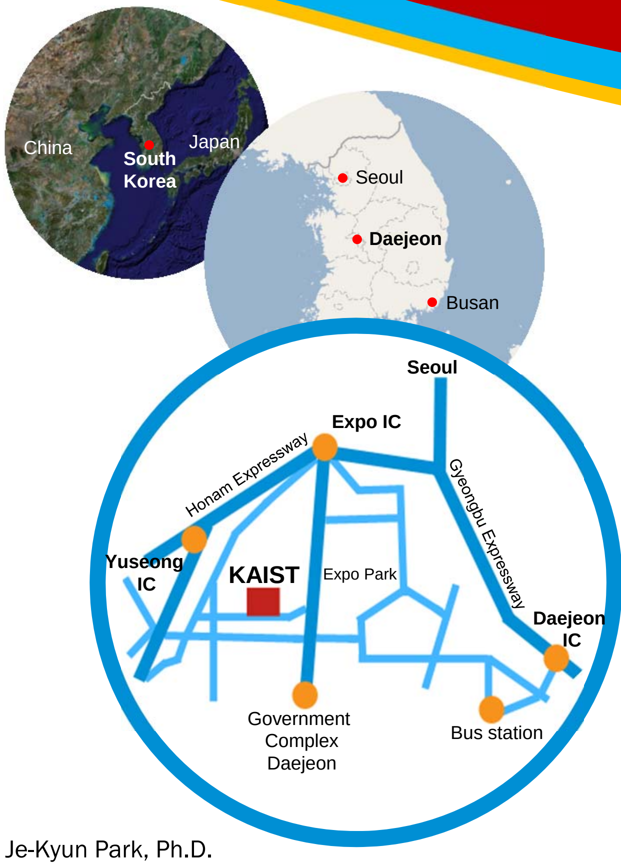
NanoBiotech Laboratory

SINCE 2002

Dr. Je-Kyun Park is the director of the NanoBiotech Laboratory and a Professor of Bio and Brain Engineering at the Korea Advanced Institute of Science and Technology (KAIST). He holds joint positions as an Affiliated Professor of Biological Sciences and KAIST Institute for the NanoCentury. He obtained his Ph.D. degree in biotechnology from the KAIST in 1992. Prior to joining KAIST, he worked as a Postdoctoral Fellow in the Department of Biomedical Engineering at the Johns Hopkins University School of Medicine in the USA (1996–1997) and a Chief Research Engineer at the LG Electronics Institute of Technology in Korea (1992–2002). He joined the Department of BioSystems at the KAIST as an Associate Professor in 2002 and served as the Department Head of Bio and Brain Engineering (2006–2009). His expertise spans interdisciplinary fields of biotechnology, bioelectronics and bioMEMS, with special emphasis on biomolecular diagnostics, micro total analysis systems (μTAS), and cell-based screening platforms. He has served as an editorial board member of several international journals, including *Lab on a Chip*, *Biosensors and Bioelectronics*, and *BioChip Journal*. In 2010, he was appointed to the Chair of the BioMEMS and Lab-on-a-chip Committee at the Korean BioChip Society. His main research focuses on the microfluidic lab-on-a-chip platform for biological sample processing and detection, including optoelectrofluidics, hydrophoretic separation, magnetophoretic assay, and cell-based assay.





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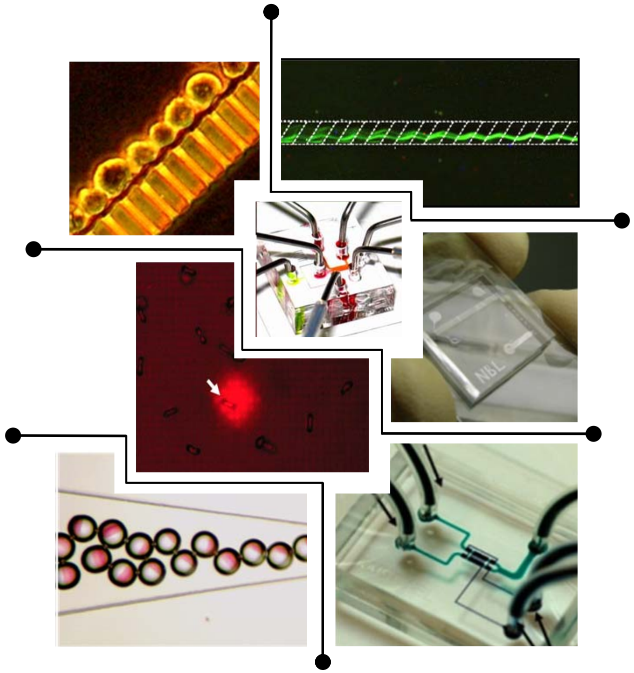

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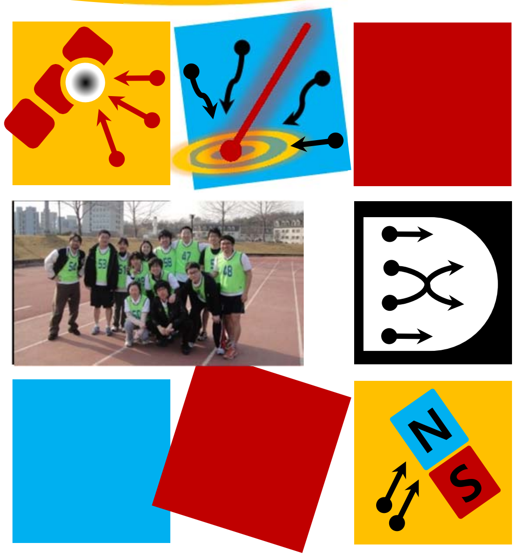
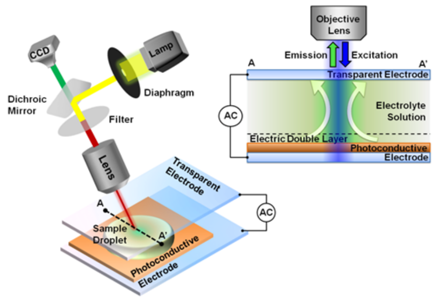
Introduction of NanoBiotech Laboratory



The aim of NanoBiotech Laboratory (NBL) lies in conducting research and development on nanobio-technology and integrative bioengineering. During the last several years, NBL has been interested in developing novel microfluidic devices for biotechnology and bioengineering, based on the synergetic integration of miniaturization technology to biology, chemistry, and medicine. Currently, NBL 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, NBL has been selected to receive a National Research Laboratory (NRL) Program grant through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology (MEST).

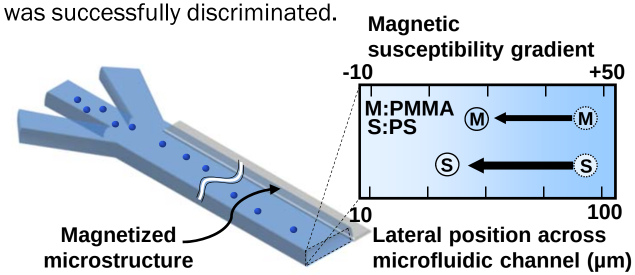
Optoelectrofluidics Platform

A novel programmable microfluidic platform that particles are manipulated by electrokinetic forces such as dielectro-phoretic or electro-osmotic force generated with a light, has been developed. When a dynamic image pattern is projected into a specific area of a photoconductive layer, virtual electrodes are generated, resulting in electrokinetic motions of micro/nanoparticles under a nonuniform electric field. This new platform may be a widely usable integrated system for optoelectrofluidic manipulation of micro/nano particles including living cells and biomolecules.



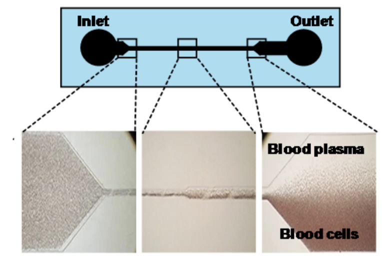
Magnetophoretic Assay Platform

A new immunoassay system was developed by using the magnetophoretic mobility of a microbead, depending on the amount of associated superparamagnetic nanoparticles under magnetic field gradient in a microfluidic channel. By measuring the magnetophoretic deflection of the microbeads varied by the concentration of analytes, the multiple disease markers are simultaneously quantified. We have also reported a novel magnetophoretic principle, *isomagnetophoresis*, employing the magnetic susceptibility gradient across a microfluidic channel. By using this method, the subtle magnetic susceptibility of microparticles was successfully discriminated.



Hydrophoretic Separation Platform

The slanted or anisotropic obstacles in a microchannel can be used to induce hydrodynamic interaction between the obstacles and the particles subjected to rotational flows induced by the obstacles. By exploiting this new hydrophoretic separation scheme, we can generate a lateral pressure gradient so that microparticles can be deflected and arranged along the lateral flows induced by the gradient. The hydrophoretic principles were successfully applied to the particle sizing, sheathless particle focusing, isolation of white blood cells, and self-sorting of mammalian cells to achieve cell cycle synchrony.



Cell-based Assay Platform

Microfluidic cell-based assay platforms, including cytotoxicity test, cell viability monitoring, drug permeability test, and biomechanical analysis, have been developed. In addition, we recently succeeded in developing a microfluidic interface that enables multiplexed immunohistochemistry (IHC) measurements on breast tissue samples. This new IHC platform has improved performance concerning time, consumption of tissue, antibodies and staining compounds, sensitivity, specificity and cost-effectiveness, and hence, it is a step towards the individualization of cancer therapy.