Introduction to Global Research Laboratory (GRL) Program:

"Molecular Imaging and Nanomedicine for Theragnosis using Nano-Bio Materials"

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The Global Research Laboratory (GRL) program was initiated by the Korea Foundation for International Cooperation of Science and Technology (KICOS) in 2006. The GRL program has been designed to develop fundamental and original technologies through international collaborative research between Korean and foreign laboratories. A proposal submitted for the GRL program should address a research topic which requires Korean and foreign research partners to engage in close collaboration for the attainment of significant scientific and technological goals.

Korea Institute of Science and Technology (KIST) and Purdue research team applied to 2007 GRL program since we have already established long term collaboration for more than 5 years and we had a good idea about future collaborative research topics. We proposed to develop the new emerging technology (Theragnosis) based on nanomedicine and molecular imaging techniques. Our GRL proposal passed both first and second rounds of competition and finally was selected from 20 international proposals.

In the presentation, I will talk about the history of KIST-Purdue collaboration and I want to have productive discussion about the details of our GRL research contents as well as the direction and plans for the future collaborations with extended Purdue faculties and industries.

The following is the summary of the GRL proposal.

Purpose of Research	To establish a new emerging technology "Theragnosis (Therapy + Diagnosis)" facilitated by nanomedicine and molecular imaging, we will develop highly advanced bio-active materials and early imaging diagnostic systems for theragnosis using nano-bio fusion technology through complementary research collaborations.
Research Contents	Nanomedicine and molecular imaging could be a strategic initiative to combine clinical and basic researches into a directed application toward theragnosis. 'Molecular imaging' includes synthesis of imaging probes, live cell imaging, early diagnosis, high throughput drug screening, development of imaging system, and 'Nanomedicine' includes drug delivery, separation, analysis, molecular diagnosis, nano biomaterials, regenerative nanomedicine as well as nano-scaled therapy. • Nano-Polymeric Particle Smart Probes for Fluorescence Optical Imaging: We will develop various nano-probes which can be utilized for biomolecule detection and early diagnosis of diseases, i.e. cancer, in live animals, and eventually in humans. • Nano-Hybrid Fusion Proteins for Cellular Imaging: Several nano-hybrid reporter proteins and fluorescence-labeled fusion proteins will be developed to evaluate the molecular mechanism of diseases in cell systems. • Nano-Hybrid Materials for Cytomics: We will develop nano-hybrid materials for futuristic cytometry system consisted of a specially designed high-speed multichannel detector, spectral analysis as well as classification software. • Nano-Bio Probes for Non-linear Optical Imaging: The novel NLO microscopy nano-bio probes for 3D molecular imaging will be developed and used to investigate the working mechanisms of biological system in diseases. • Nano-Sized Drug Carriers for Nanomedicine: Nano-sized drug carriers will be developed for extension to a pre-clinical study. The therapeutic efficiency will be studied *in vitro* and *in vivo* using various molecular imaging systems. • Nano-Factory for Cell Engineering: Nanoparticulated drug/therapeutic gene containing nano-factories will be developed for nanomedicine. This *in vivo* nano-factory therapeutics involves rare-event targeting and unique high-throughput cell analysis technologies. • Nano-Bio Dot for Microwave Thermotherapy: Thermo sensitive nano-bio dot can be easily delivered to cancer tissues due to its high vascularity, and microwave energy can heat nano-bio dot and selectively damage cancer cells.
Expected Research Outputs	• We will establish the new approaches toward the theragnosis by developing novel nano-bio materials with global collaborations, raising the research fields of molecular imaging and nanomedicine to a new level to be internationally competitive. • Newly developed nano-bio fusion materials and innovative diagnosis tools for medical treatments will create high impact on the academic research and also generate new bio-industrial markets.