Interdisciplinary Platforms for Nano-BioSensing

INITIATIVE
The most powerful characteristic of the research environment in Discovery Park is the “potential to transform basic research to real world application.” Discovery Park’s interdisciplinary culture brings together faculty from across disciplines to address challenges that cannot be tackled by just one discipline or that lies at the boundary of disciplines. In addition to faculty collaborations, the Discovery Park centers (for example, the Bindley Bioscience Center and the Birck Nanotechnology Center) engage other campus centers such as the Purdue University Center for Cancer Research and the Center for Food Safety Engineering to develop comprehensive solutions.

IMPACT
The results of these interdisciplinary collaborations are new platforms for biosensing based on the exploitation of some of these novel and unique nanomaterials. These platforms are being developed, tested and applied to numerous different biosensor applications. Faculty engaged in such transformative efforts span the Colleges of Engineering, Agriculture, Science, Pharmacy and Veterinary Sciences and the Department of Nutrition Science.

Among several examples of high impact interdisciplinary research, Fig 1 shows a Lab on Chip optofluidics concept developed between the groups of Steve Wereley and Joseph Irudayaraj (Lab on Chip 12, 4955-4959, 2012, reviewed in Nature Photonics, Vol. 7, Jan. 2013) to concentrate and separate cells. Dr. Irudayaraj’s group has also shown that mRNA can be quantified at splice variant resolution in live cells (Nature Nanotechnology, 2014). Fig 2, shows an example of mapping drug distribution by fluorescence lifetime imaging (A) and chromosomal spread from brain cancer cells for detecting epigenetic mutations (Irudayaraj). Fig 3, shows ongoing efforts to weigh single cells and nanoparticles in the Cagri lab.

Dr. Choi’s lab is developing carbon nanotube (CNT) biosensors (Fig. 4) for detecting insuling (collaborators are Drs. Porterfield and Rickus). This work is now being expanded to create DNA Oragami structures for DNA patterning. Pioneering drug discovery efforts by Dr. Phil Low, creation of nanoparticle sensors by Drs. Wei, Thomson, Yeon and Park, and implantable sensors by Dr. Babak are other notable efforts among other ongoing efforts in nanobiotechnology efforts in Purdue’s Discovery Park.