

# DNA Origami Nanorobots for Early Cancer Detection

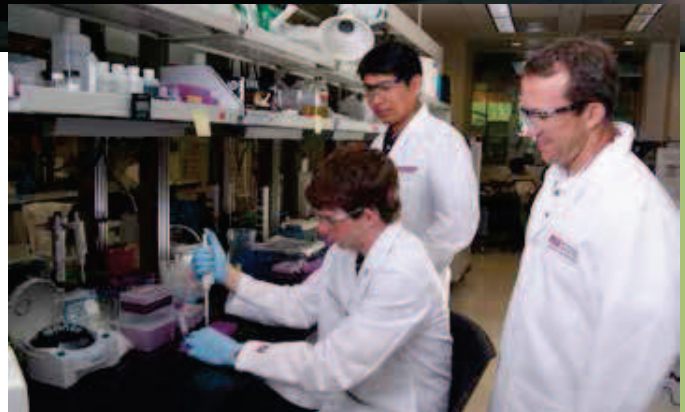


The goal of this research is to develop DNA-origami-based nanorobots, decorated with antibodies, aptamers and high-brightness nanoparticles, for cancer cell detection. The devices will have the capacity to carry therapeutic and biochemical fingerprinting technologies for in-cell theranostics—the combination of therapeutics and diagnostics.

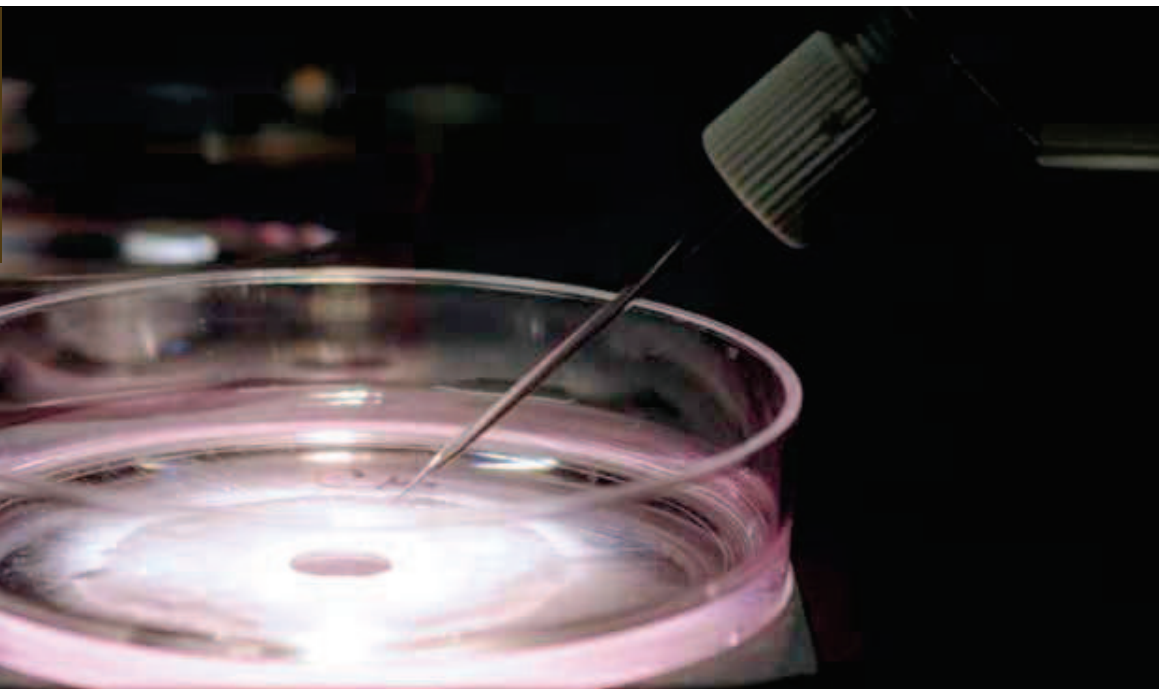
The nanorobots will be autonomous, nanoscopic devices capable of analyzing multiple biomarkers that signal the presence of disease (diagnostic), and initiate corrective actions when needed (therapeutic). We intend to focus on 3-D objects made of DNA that we refer to as nanobots; these nanobots will be held in a closed conformation by molecular locks and then opened (unlocked) by external cues transduced by molecular sensors. The main focus of our initial research efforts are to develop engineering strategies to construct the nanobot framework.

We will engineer the most desirable nanorobot form using DNA origami technology, exploring the ideal size, shape, and arrangement of the shell to facilitate decoration by molecular sensors. We will develop the conjugation chemistry necessary to functionalize the DNA nanobots with antibodies and aptamers for molecular detection of desired cancer biomarkers.

One of the overarching goals of the larger project is to monitor targeted delivery of the drug payload to cancer cells. We intend to achieve this by incorporating a DNA aptamer that recognizes and binds to galladium, an MRI contrast agent, into the nanobots. The fate of the galladium tagged nanobots will be monitored by MRI.



The Yan lab at ASU has extensive experience designing and constructing DNA origami based nanostructures and molecular devices. They have been utilizing and developing DNA origami technology since its inception in 2006, and are ideally suited to exploit the highly desirable and adaptable properties of DNA origami nanostructures for device construction. For example, the team successfully constructed a DNA nanobox with a molecular lock mechanism that is unlocked by an external DNA key. In other work, they demonstrated that protein molecules can be efficiently captured within rectangular shaped nanocontainers. The team offers a solid foundation for the development of theranostic nanorobots based on DNA-directed self-assembly.



### **Dr. Hao Yan**

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Dr. Yan earned his bachelor's degree in chemistry at Shandong University, China. He obtained his PhD in chemistry from New York University in 2001, working on design and construction of sequence-dependent DNA nanomechanical devices. He then moved to Duke University, where he continued to explore his interests in DNA-based molecular computing and programming. Following a three year period as an assistant research professor at Duke, he joined ASU as assistant professor in the Department of Chemistry and Biochemistry in 2004. In 2008, he was promoted with early tenure directly to full professor and he is currently the Milton D. Glick Distinguished Professor in Chemistry and Biochemistry. The theme of his research is to use nature's design rules as inspiration to advance biomedical, energy-related, and other technological innovations through the use of self-assembling molecules and materials.

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### **Professor Richard O'Kennedy**

Director and Professor  
Applied Biochemistry Research Group

Professor O'Kennedy is professor of biological sciences and director of the Applied Biochemistry Research Group, internationally recognised for its expertise in immunoassays, antibody generation, education and training. Since 2004, he has been a principal investigator and leader in education and outreach at the Biomedical Diagnostics Institute (BDI). From 2009 to 2012, he was vice president for learning innovation of DCU. In 2013, he was appointed scientific director of the BDI.

He has published extensively and has worked closely with many Irish and international companies and has been involved with various spin-out companies. Since 2006, Dr. O'Kennedy has been programme chair of the M.Sc. in Biomedical Diagnostics.

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