

Small-Molecule Detection and Enantiopurity Measurement using DNA-Based Sensors

Nucleic acids are exquisitely adept at molecular recognition and self-assembly, enabling them to direct nearly all of the processes that make life possible. These capabilities have been fine-tuned by billions of years of evolution, and more recently, have been harnessed in the laboratory to enable the use of DNA and RNA for applications that are completely unrelated to their canonical biological roles. In our lab, we seek to gain a deeper understanding of the molecular recognition properties of nucleic acids, and to harness these properties for applications in biosensing and bioimaging. One area of our research involves using DNA aptamers as recognition elements for the development of new small-molecule detection and characterization assays. A central goal in these experiments is to pursue novel analysis techniques that are not possible using antibodies. For example, the ability of aptamer biosensors to provide a direct fluorescence signal in response to target molecule, combined with our ability to synthesize both enantiomers of DNA, enables the high-throughput measurement of small-molecule enantiopurity. We have also found that unlike antibodies, aptamers retain their molecular recognition properties in the presence of surfactants and reducing agents, which opens the door to new methods for the discovery of disease biomarkers.