Despite intense research efforts, therapeutic efficacies in multiple cancer types are sorely lacking. However, early detection of tumor formation can substantially improve patient prognosis via reduced probability of metastasis, improved therapeutic effectiveness, and reduced tumor burden. Our research applies engineering principles to chemistry, biology, and physiology to enhance the limits of disease detection, with a particular focus on in vivo molecular imaging of tumors. Molecular imaging is the non-invasive detection, localization, and quantification of molecules and molecular processes in the body. This approach can yield increased specificity and sensitivity relative to traditional imaging and enable a molecular understanding of disease biology thereby providing utility for diagnostics, therapeutic monitoring, drug development, and scientific research.

Imaging living systems at the molecular and cellular scale necessitates command of molecular recognition, molecular biology of the target, biological transport at the tissue and cellular levels, and detection technology. Our program benefits from focused research on high-throughput engineering of molecular recognition proteins with exceptional affinity, stability, and biological properties. This is coupled with in silico, in vitro, and in vivo studies of the biology and transport of the molecular target to yield efficient, selective delivery. These innovations are merged with multimodality imaging technologies to enhance detection. Tangentially, lessons learned in these endeavors are also directly applicable to (a) engineering proteins for industrial, scientific, and therapeutic applications; (b) in vitro diagnostics; (c) tumor targeting for therapeutic applications; and (d) targeting of other malignancies or molecules of scientific interest.

Awards
Institute for Engineering in Medicine Faculty Career Development Award
Selected Publications


