Final Seminar

Fluorescent and Colorimetric Biosensors Based on DNAzymes and DNA Aptamers

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Abstract:

Since the invention of combinatorial selection of functional nucleic acids, a large number of catalytic DNA (DNAzymes), DNA aptamers, and aptazymes (aptamer-regulated DNAzymes) have been isolated, many of which possess high target recognition properties. As a result, these functional nucleic acids can be used for sensing and diagnostic applications. On the other hand, technologies for sequence-selective DNA detection have advanced remarkably. Two primary examples are molecular beacon-based fluorescent detection and nanoparticle assembly-based colorimetric detection. If the methods employed for DNA detection can be applied for signaling catalytic or binding events of functional nucleic acids, sensors that can target a broad range of analytes beyond DNA can be obtained. Therefore, this seminar is focused on my thesis research on designing and testing fluorescent and colorimetric sensors with functional nucleic acids. First, a lead(II)-specific DNAzyme was employed as a target recognition element. A previously designed catalytic molecular beacon fluorescent lead(II) sensor was improved by using multiple quenchers. The improved sensor was further miniaturized with microfluidic devices. Metal-induced folding of the DNAzyme was studied to pursue the possibility of a reversible sensor based on conformational change of the DNAzyme. By introducing DNA-functionalized gold nanoparticles, colorimetric lead(II) sensors were designed based on either lead(II)-directed assembly of nanoparticles or lead(II)-induced disassembly of nanoparticles aggregates. Most DNAzymes only recognize metal ions, while aptamers can target a diverse range of analytes. Finally, colorimetric sensors employ aptamers and aptazymes were also demonstrated so that a broad range of analytes can be detected.