

Molecular diagnostic tools employing nucleic acid processing enzymes and probes and their application in nucleic acid detection

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Various DNA-processing enzymes have been discovered, including ligase, exo-/endo-nuclease, and polymerase, and provided excellent tools to process and manipulate DNA in a sophisticated manner combined with an increased understanding of their functions. The co-employment of such enzymes and specifically designed DNA strands has shown great potential to use them as molecular tools for advanced biosensing and bioimaging. In this work, we have shown a few examples of using various nuclease enzymes to develop new biosensors for the sensitive detection of nucleic acid biomarkers. Firstly, we co-employed different types of DNA-functionalized nanoparticles with nuclease enzymes to induce enzyme-triggered signal amplification, achieving ultrasensitive and selective detection of nucleic acids. We have also developed robust and straightforward strategies using isothermal rolling circle amplification that enable the facile synthesis of DNA strands to induce signal amplification. Thus, combining these with precisely designed DNA and amplification strategies, we can envision new assays with excellent merit figures for detecting and quantifying DNA and RNA sequences in a highly sensitive manner.