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Title: Nanomaterials for Colorimetric DNA Detection

Abstract: Nucleic acid testing is now widely accepted to be the gold standard for pathogen detection in a broad spectrum of applications, including medical diagnostics, food safety monitoring, and environmental surveillance. These assays are virtually performed in resource-rich clinical/central laboratories due to the use of expensive, bulky, and sophisticated equipment. The ability to achieve point-of-care/field testing can provide more timely treatment/response decision. Colorimetric detection is one of the promising technologies in view of its simple signal readout (interpretation by the naked eye and quantification by absorbance measurement). Over the past two decades, nanomaterial-based colorimetric probes have received tremendous attention for the detection of specific DNA/RNA sequences. Our team has focused on two types of nanomaterials: (1) gold nanoparticles (AuNPs) and (2) platinum nanoparticles supported on reduced graphene oxide (PtNPs/rGO). For AuNPs (unique interparticle distance-dependent optical property: red-shift of surface plasmon resonance absorption band upon particle aggregation), our team developed three assay platforms (oligonucleotide-modified AuNP with a silica reinforcement coating for polymerase chain reaction (PCR); carboxyl-modified AuNP for loop-mediated isothermal amplification (LAMP); and poly(ethylene glycol) and carboxyl co-modified AuNP for LAMP). For PtNPs/rGO (superior peroxidase-like activity), our team developed two assay platforms (π-stacking interaction with single-stranded but not double-stranded DNA as well as salt-induced aggregation for PCR; and pH-dependent activity for LAMP). These assay platforms would enable ultrasensitive, simple, and low-cost nucleic acid testing in decentralized settings.

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