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Aptamer-Functionalized Gold Nanoparticles as Probes in a Dry-Reagent Strip Biosensor for Protein Analysis

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The highly specific molecular recognition properties of aptamers are combined with the unique optical properties of gold nanoparticles for the development of a dry-reagent strip biosensor that enables qualitative (visual)/quantitative detection of protein within minutes. A model system comprising thrombin as an analyte and a pair of aptamer probes is used to demonstrate the proof-of-concept on the conventional lateral flow test strip. The assay avoids the multiple incubation and washing steps performed in most current aptamer-based protein analyses. Although qualitative tests are realized by observing the color change of the test zone, quantitative data are obtained by recording the optical responses of the test zone with a portable "strip reader". The response of the biosensor is linear over the range of 5−100 nM of thrombin with a detection limit of 2.5 nM (S/N = 3). By comparing the analytical performances of the aptamer-based strip biosensor with the antibody-based strip sensor, we can demonstrate that aptamers are equivalent or superior to antibodies in terms of specificity and sensitivity, respectively. The sensor was used successfully for detection of thrombin in human plasma samples. It shows great promise for use of aptamer-functionalized gold nanoparticle probes in dry-reagent strip biosensors for point-of-care or in-field detection of proteins.

cence,[4] quartz crystal microbalance,[5] and surface-enhanced raman spectroscopy.[6] Although these conventional strategies provide accurate, sensitive detection of proteins, there are still some inconveniences that exist, such as the utilization of radioactive substances, time-consuming sample purification, incubation, washing steps before analysis and enzymatic reactions, and technical expertise as well as the specialized equipment. Recently, a lateral flow biosensor, also called a dry-reagent strip biosensor, using combined chromatography with conventional immunoassay has gained increasing attention in protein analysis and clinical diagnosis.[7−9] Compared with the methods mentioned above, such a lateral flow biosensor has several advantages: user-friendly format, very short assay time (generally several minutes), less interference due to chromatographic separation, long-term stability over a wide range of climates, a relatively low cost, and no requirements for skilled technicians. This ideal technique is suitable for on-site testing by people who are untrained analysts.[10] Today, most of these methods that lately have been extensively applied are based on the use of antibodies as affinity reagents. For example, Shim et al.[11] have used a colloidal gold-antibody probe for the detection of atrazine in water samples. Sithigorngul et al.[12] applied a simple and rapid method for detection of pathogenic isolates of *Vibrio harveyi*. However, the utilization of antibodies may encounter some drawbacks with their production, stability, and modification, and searching for other alternative candidates is ongoing. Aptamers, the artificial nucleic acid ligands,