Rapid Diagnostics for Infectious Disease using Noble Metal Nanoparticles

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Rapid point-of-care (POC) diagnostic devices are needed for field-forward screening of severe acute systemic febrile illnesses such as dengue, Ebola, chikungunya, and others. Multiplexed rapid lateral flow diagnostics have the potential to distinguish among multiple pathogens, thereby facilitating diagnosis and improving patient care. We present a platform for multiplexed pathogen detection which uses gold or silver nanoparticles conjugated to antibodies to sense the presence of biomarkers for different infectious diseases. We exploit the size-dependent optical properties of Ag NPs to construct a multiplexed paperfluidic lateral flow POC sensor. AgNPs of different sizes were conjugated to antibodies that bind to specific biomarkers. Red AgNPs were conjugated to antibodies that could recognize the glycoprotein for Ebola virus, green AgNPs to those that could recognize nonstructural protein 1 for dengue virus, and orange AgNPs for non structural protein 1 for yellow fever virus. Presence of each of the biomarkers resulted in a different colored band on the test line in the lateral flow test. Thus, we were able to use NP color to distinguish among three pathogens that cause a febrile illness. Because positive test lines can be imaged by eye or a mobile phone camera, the approach is adaptable to low-resource, widely deployable settings. This design requires no external excitation source and permits multiplexed analysis in a single channel, facilitating integration and manufacturing. We will also discuss engineering the nanoparticle physical properties and surface chemistry for improving detection and also optimizing device properties, and expansion of the device to detect other diseases.

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