

## Coordinated Assembly of Gold Nanoparticles Enables Signal Self-Enhancement for Accurate and Rapid One-Step-Immunoassays

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Current immunoassays are in general performed through time-consuming multi-step procedures that depend on signal-producing reporters and often cause assay inaccuracy. Here we report a new paradigm of immunoassay technology that resolves the delayed, complex, and inaccurate assay problems, i.e. an accurate, rapid, simple, and label-free one-step-immunoassay based on signal self-enhancement by gold nanoparticles assembly in an assay solution. Engineered protein particle-based 3-dimensional probes chemisorb gold ions via coordination bond as well as sensitively detect both antigen and antibody analytes. Systematic numerical and experimental analyses show that the signal self-enhancement happens through two coupled reactions under a reducing condition: 1) 3D probe-based sensitive immunoassay and 2) coordinated assembly of free and chemisorbed AuNPs. The advanced one-step-immunoassay was applied to the diagnostic assays requiring high accuracy and speed, i.e. diagnosis of acute myocardial infarction and hepatitis C through detecting a cardiac protein and anti-viral antibodies in patient sera, indicating it is applicable to accurate and rapid diagnosis of a wide range of diseases.