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Abstract:

Addressing the need for accessible SARS-CoV-2 testing, carboxy-PEG 12-thiol functionalized gold nanoparticles conjugates were developed for rapid point-of-care (POC) detection against SARS-CoV-2 spike protein, pseudo-SARS-CoV-2, and authentic Beta SARS-CoV-2 virus particles. These conjugates leverage gold nanoparticles (AuNPs) as signal transducers, cross-linked to either angiotensin-converting enzyme 2 (ACE2) or SARS-CoV-2 spike protein receptor-binding domain (RBD) antibodies as bioreceptors and showed a distinct color shift from pink to blue. To assess their POC feasibility, the conjugates were integrated into facemasks and breathalyzers, wherein aerosolized SARS-CoV-2 antigens were successfully detected, producing a color change within 10 and 30 minutes for the breathalyzer and facemask prototypes, respectively. Furthermore, we explored quantitative analysis using varying concentrations of SARS-CoV-2 spike protein. Both conjugates demonstrated a linear relationship between blue color intensity and virus concentration, with linear ranges of 0.08–0.6 ng/mL and 0.04–0.5 ng/mL, respectively. Low limits of detection and quantification were also achieved. They exhibited specificity, responding solely to SARS-CoV-2 even in complex matrices containing diverse proteins, including the SARS-CoV-1 spike protein. Precision tests yielded coefficient of variations below 2 %, showcasing their remarkable reproducibility. This work presents a promising approach for rapid, sensitive, and specific POC detection of SARS-CoV-2 paving the way for improved pandemic response and management.