Precise detection of specific biomarkers in human fluids is compulsory for disease diagnosis, risk stratification, and treatment.

Gold nanostars absorb near-infrared light in their centers and focusing the absorbed light at the tips of their branches. This behavior leads to localized surface plasmon resonance, causing electromagnetic enhancement and increased sensitivity.

The Raman tags used have characteristic peaks that do not overlap, supporting specific multiplexing.

Translation to a microfluidic enables multiplexed detection in small sample volumes. The PDMS and glass microfluidic device can be reused over multiple cycles, reducing operational costs.

To verify PRADA as an inexpensive method of achieving quantitative, specific, and sensitive single- and multiplex biomarker detection.

Currently, the most prevalent method is the enzyme-linked immunosorbent assay, or ELISA. ELISA can only detect one biomarker at a time, requires large sample volumes and has high operational costs.

PRADA eliminates disadvantages through the use of a sandwich assay with magnetic microbeads and gold nanostars, allowing multiplexed biomarker detection in resource limited settings.

Copper microbeads immobilized by a magnet for the duration of screening can be washed away afterward, allowing for reusability.

Biomarkers tested for here are cardiac troponin I (cTnI), a biomarker of myocardial infarction, and neuropeptide Y (NPY), a biomarker of anxiety and PTSD.

Gold nanostars are conjugated with Raman tags and peptides to form detection probes.

Capture probes are held in place by a magnet and incubated with buffer or serum containing biomarkers of interest in different concentrations to prove sensitivity.

After removing the magnet, samples may be archived, and the microfluidic device is washed and used again to prove reusability.

PRADA demonstrates a decrease in peak intensity corresponding to a decrease in concentration, with a limit of detection of 0.1 ng/mL.

After reuse of the same microfluidic device over 15 cycles, PRADA experienced less than 4% signal loss.

PRADA is a sensitive and specific technique for quantitative biodiagnostics.

PRADA can be performed repeatedly on a microfluidic device with little effect on accuracy.

In the future, a sensitivity curve for NPY needs to be determined, screening for multiple biomarkers needs to be done, and a range of clinical patient samples need to be analyzed.

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References