Washington University in St. Louis
Office of Technology Management

SIMPLE, STABLE PLASMONIC BIOSENSORS FOR POINT-OF-CARE DIAGNOSIS OF CARDIAC ARREST AND OTHER CONDITIONS

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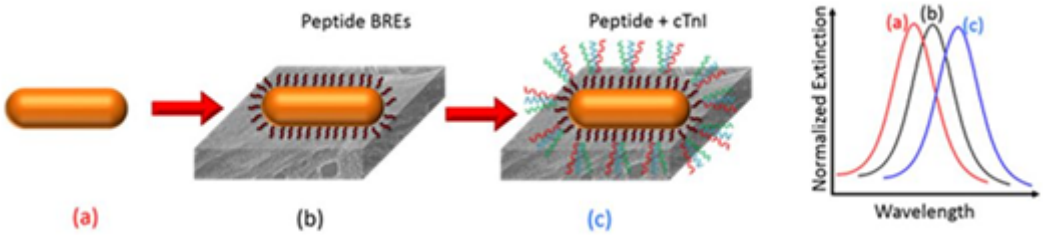
Technology Description

An interdisciplinary team of researchers at Washington University have developed a sensitive, shelf-stable, label-free system for quickly quantifying biomarkers in point-of-care settings (e.g., office, ambulance or battlefield). Localized surface plasmon resonance (LSPR) offers a powerful approach for cost-effective lab-on-chip point-of-care diagnostics. However, LSPR typically detects biomarkers using antibodies that are costly to generate; have limited sensitivity due to their large size; and have limited pH and temperature stability, . This technology solves those problems by replacing antibodies with stable, highly specific aptamer/peptide recognition elements. This system was demonstrated by using gold plasmonic nanotransducers conjugated with aptamers to detect the cardiac biomarker troponin I. This technology offers a platform for rapid, low-cost point-of-care diagnostics for a variety of applications, particularly in resource-limited settings.



Biosensor with peptide recognition elements. *(a) gold nanotransducer (b) nanotransducer with peptide biorecognition element (BRE) (c) nanotransducer with peptide BRE bound to Troponin I (cTnI) target molecule.*

Stage of Research

The inventors have demonstrated that short peptide (aptamer) biorecognition elements on gold nanotransducers in a bioplasmonic paper device are more sensitive and specific for detecting troponin I than when larger antibodies are used as target capture agents.

Applications

- **Point-of-care diagnostics** – plasmonic biosensors for label-free, quantitative detection of biomarkers in body fluids using simple substrates and low-cost portable equipment
  - demonstrated for troponin I detection, the most common clinical biomarker of myocardial infarction
  - easily adapted to other biomarkers of interest by functionalizing the nanotranducers
  - potential for multiplexed bioplasmonic paper device (BPD) to improve sensitivity or detect

biomarkers for multiple conditions

Key Advantages

- **Shelf-stable detection molecules –** aptamer peptides:
  - have remarkable chemical, temporal and environmental stability
  - retain target-recognition capability after exposure to elevated temperatures
  - enable easy handling with no special storage conditions
- **Point-of-care**:
  - potential for simple, rapid and reliable diagnostic platform that can be deployed in even in low resource or austere settings such as an ambulance, battlefield or remote location
  - analysis with a simple, low-cost, handheld vis-NIR spectrometer
  - could hasten therapeutic intervention and save lives by eliminating the time needed for processing samples in a centralized laboratory
- **Sensitive**:
  - enhanced LSPR response
  - aptamer recognition has higher sensitivity and a lower detection limit than antibody-based detection
  - small size of the aptamers minimizes exponential decay in refractive index sensitivity from the surface of the nanotransducers

Publications

- Tadepalli, S., Kuang, Z., Jiang, Q., Liu, K. K., Fisher, M. A., Morrissey, J. J., ... & Singamaneni, S. (2015). Peptide functionalized gold nanorods for the sensitive detection of a cardiac biomarker using plasmonic paper devices. *Scientific reports*, 5, 16206.

Patents

- Bioplasmonic detection of biomarkers in body fluids using peptide recognition elements (U.S. Patent Application Publication No. US20180031483A1)

Website

- Soft Nanomaterials Laboratory