PLASMONIC COFFEE-RING PATTERN DIAGNOSTIC DEVICES AND METHODS OF MAKING AND USING THEM

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PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Published Application	WO2025160588	07/31/2025	2024-043

BRIEF DESCRIPTION

The reliable detection of trace amounts of analytes, such as disease biomarkers or environmental toxins, requires complex and often time-consuming laboratory techniques, limiting rapid point-of-care diagnostics. This innovation provides a simple, rapid, and highly sensitive diagnostic method, termed Plasmonic Coffee-Ring Pattern Diagnostic Devices, for detecting analytes of interest. The core technology, developed by researchers, involves a specialized nanoporous or mesoporous hydrophilic membrane that has been chemically treated to achieve an intermediate wettability (intermediate between hydrophilic and hydrophobic). A drop of sample is allowed to dry on this treated membrane, capturing any target analyte. A subsequent, overlapping drop of functionalized gold nanoshells is applied, which interacts with the immobilized analyte to form a distinct, visible plasmonic pattern (a "coffee-ring" effect) that signals the analyte's presence. This pattern-based method enables the detection of analytes at concentrations as low as 5 pg/mL, offering an order-of-magnitude increase in sensitivity compared to many alternative rapid diagnostic platforms. Furthermore, the reproducible pattern can be read and interpreted using machine learning-assisted embodiments to precisely quantify the analyte present in the sample.

SUGGESTED USES

- Rapid, ultra-sensitive diagnostic testing for infectious diseases (e.g., viral or bacterial pathogens) at the point-of-care.
- Early-stage detection and monitoring of trace biomarkers for chronic diseases (e.g., cancer, cardiac conditions) from body fluid samples.
- Environmental monitoring for trace contaminants, toxins, or pollutants in water or air samples.
- Food safety screening for allergens, pathogens, or adulterants at ultra-low levels.
- Drug monitoring and therapeutic drug management where minute concentrations must be measured.

ADVANTAGES

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OTHER INFORMATION

CATEGORIZED AS

» **Materials & Chemicals**
» Nanomaterials
» **Medical**
» Diagnostics
» **Nanotechnology**
» NanoBio
» **Sensors & Instrumentation**
» Analytical
» Biosensors

RELATED CASES

2024-043-0

● Ultra-High Sensitivity: Achieves detection limits as low as 5 pg/mL, offering a significant improvement over many current rapid diagnostic tests.

● Simplicity and Speed: The core assay relies on simple drop-drying and visual pattern formation, making it highly suitable for fast, inexpensive, point-of-care use.

● Versatile Platform: The core membrane and gold nanoshells can be functionalized to detect a wide array of target analytes, including proteins, antibodies, and nucleic acids.

● Quantification Potential: Integration with machine learning allows for the quantitative determination of analyte concentration, moving beyond simple qualitative results.

● Controlled Deposition: The treated membrane's intermediate wettability is key to creating a reproducible and clear "coffee-ring" pattern, enhancing reliability and readout clarity.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Three-Dimensional Imaging Via Piezoelectric Micromachined Ultrasound Transducer
- Subcutaneous and Continuous Blood Pressure Monitoring by PMUTS
- Reconfigurable Soft Li-Ion Battery
- Fabrication of enhanced supercapacitors using atomic layer deposition of metal oxide on nanostructures
- Wafer Level Chip Scale Packaging Technology For Integrated Mems Devices

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