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# FIELD-DEPLOYABLE MICROFLUIDIC IMMUNOASSAY DEVICE FOR PROTEIN DETECTION

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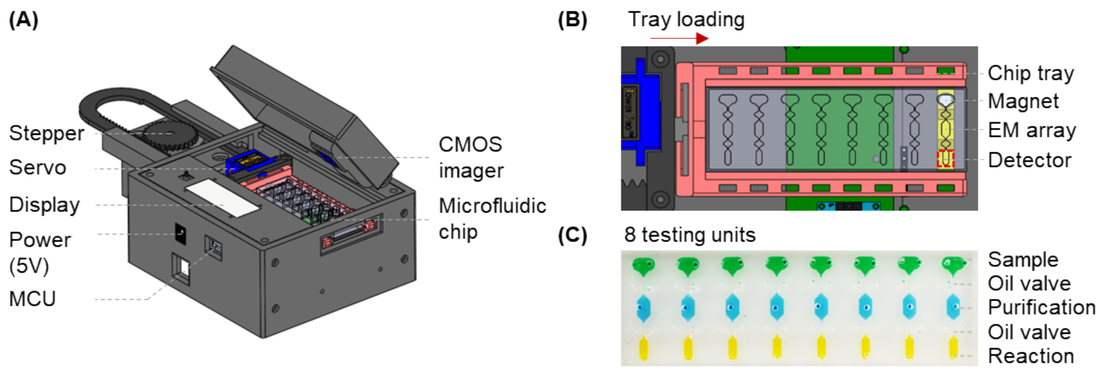
## Introduction

- Identifying specific protein biomarkers is a critical clinical procedure for timely and cost-effective diagnosis.
- Development of mobile and low-cost technology for sensitive protein detection is of interest in the clinical setting.
- Microfluidic approach is well suited for on-site clinical diagnosis because of portability, low sample/reagent volumes, and automated processing.
- Microparticles are frequently used because their high surface-to-volume ratio can significantly reduce assay time while improving sensitivity.
- Implementing bead-based immunoassays relies on the strategic actuation of beads and liquid droplets in a controllable manner.
- Integrating reliable, robust, and automated front-end immunoassay is still a common hurdle for most existing point-of-care microfluidic devices.

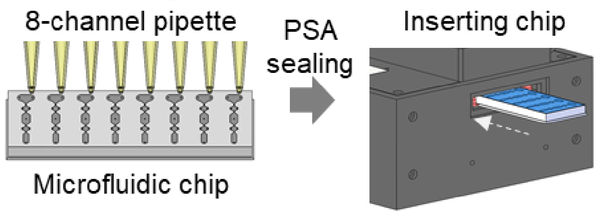
## Instrumentation




- Platform footprint: 11×12×8 cm.
- Optical and electromechanical subsystems.
- A single microfluidic chip contains 8 testing units

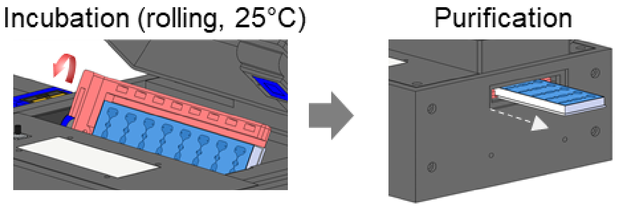
## Workflow

**1. Sample loading (1 min)**



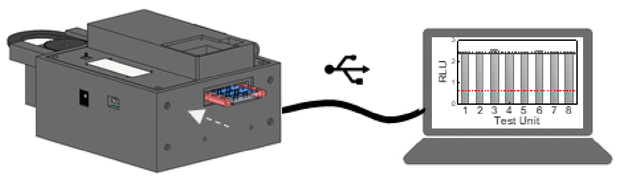

- ***Step 1:*** Load sample using 8-channel pipette, then seal microfluidic device with pressure sensitive adhesive.

**2. Automated sample process (36 min)**



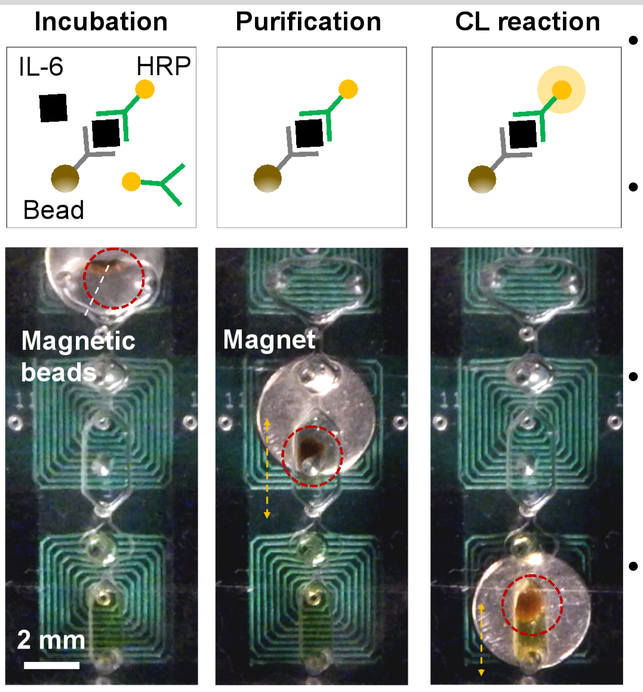

- ***Step 2:*** Insert microfluidic chip to platform, then press start button. The platform processes samples in automated fashion (*i.e.*, incubation and purification).

**3. CL measurement / analysis (8 min)**



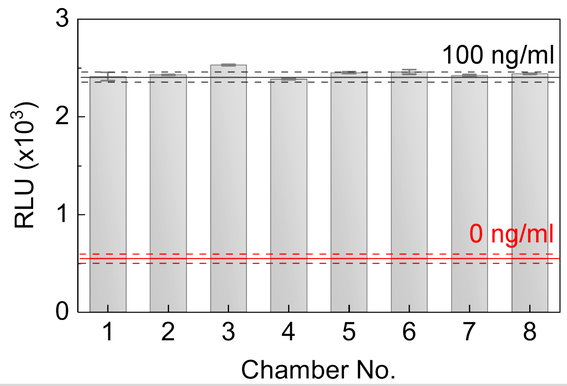

- ***Step 3:*** CL signal from each testing unit is measured one at a time; then analyzed.

## Automated Sample Process



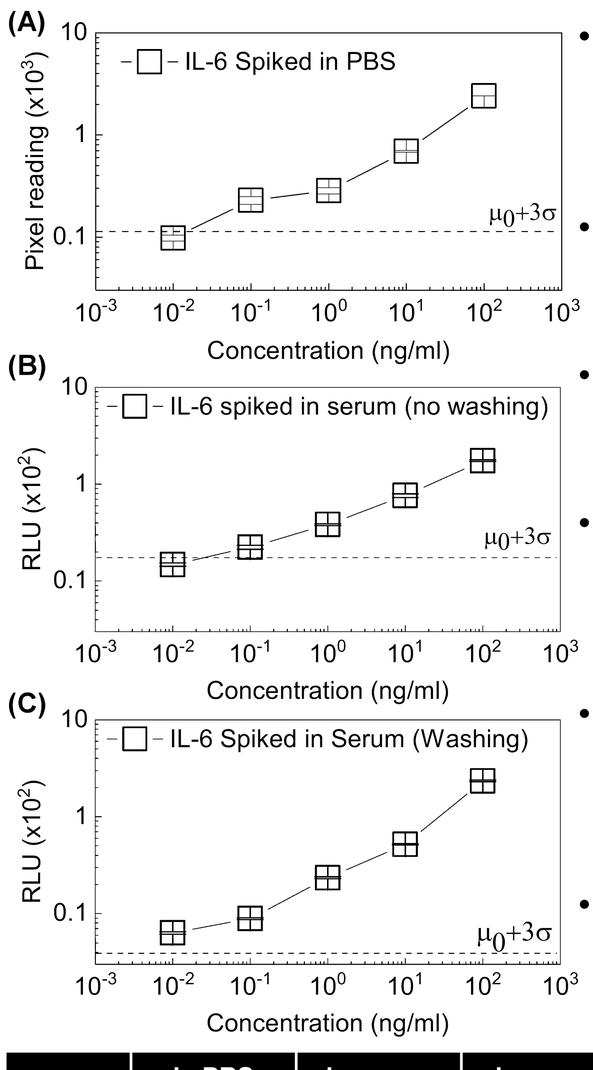

- Bead-based immunoassay is performed in microfluidic chip without user intervention.
- Magnetic beads are actuated by controlled magnet motion on electromagnet micro-actuators.
- ***Purification:*** Beads are agitated to remove the reagent carryovers from the sample chamber.
- ***Reaction:*** Washed beads are transferred to the reaction chamber for CL measurement.

## Uniformity




- The quantitative results among 8 testing units showed excellent uniformity (100 ng/ml: 2410 ± 50, 0 ng/ml: 548 ± 20).
- Robust reagent mixing & washing during the sample prep. and consistent bead transfer.

## Sensitivity




- The device facilitated the sandwich immunoassay on the microfluidic chip in automated manner.
- The linear standard curve showed the quantitative ability of system.
- Without purification, sample matrix effect was observed with serum spiked samples.
- This is mainly due to the unbound HRP-labeled detector antibodies carryovers to CL reaction chamber.
- With purification, the detection limit of 10 pg/ml was achieved with the presence of sample matrix.
- Sample purification mitigates sample matrix hindrance and enables sensitive detection.

| | in PBS (no wash) | in serum (no wash) | in serum (wash) |
|---|---|---|---|
| S:B | 4.2 | 2.8 | 5.2 |
| LOD (pg/ml) | 480 | 480 | 10 |

- Result from serum spiked sample also indicates that the assay is specific to the IL-6.

## Conclusion

- A mobille platform operates eight microfluidic immunoassay tests for sensitive protein detection in 45 minutes.
- Integrated planar electromagnetic actuator enables robust and automated front-end immunoassay without user intervention.
- Achieved detection limit of 10 pg/ml with IL-6 spiked in human serum.
- Enables immunoassay for accurate & timely diagnosis at point-of-need.

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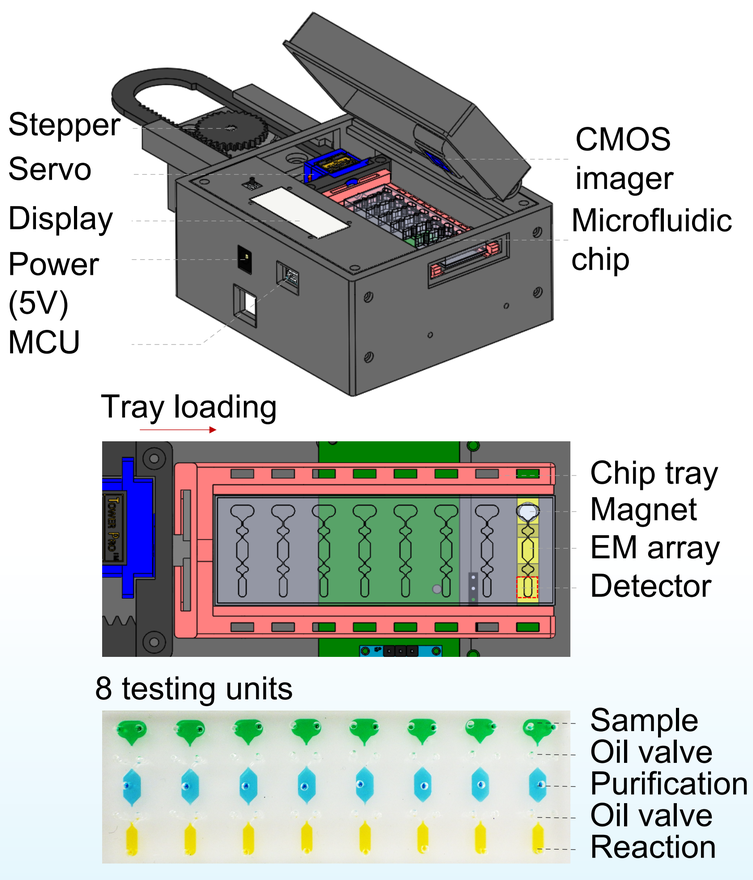


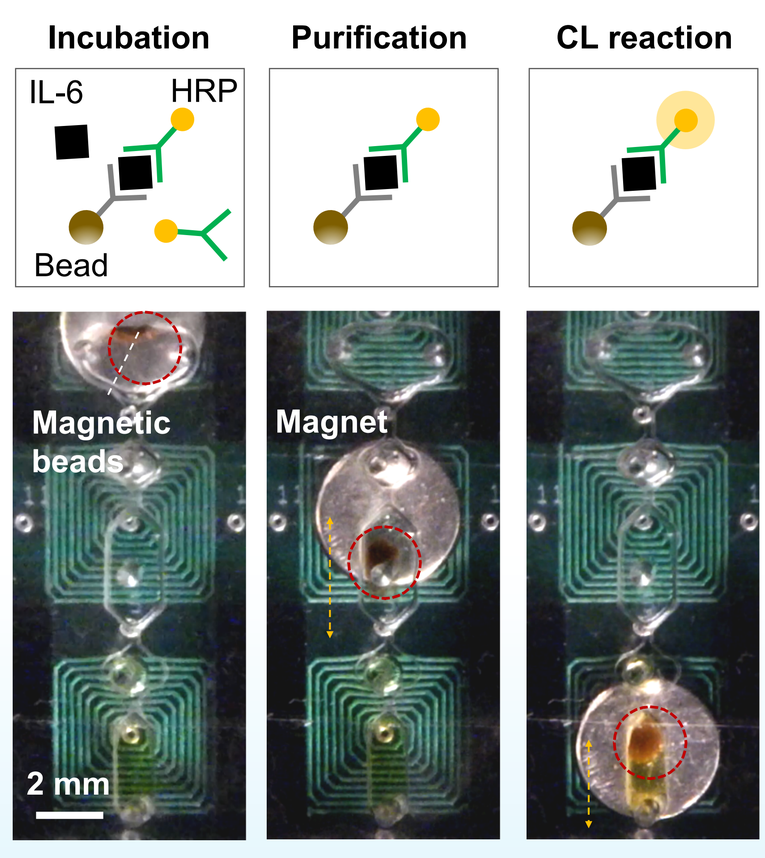


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