

# UCLA

## Posters

### Title

Field Operational Sensor and Lab-on-a-Chip System for Marine Environmental Monitoring and Analysis

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## Field Operational Sensor and Lab-on-a-Chip System for Marine Environmental Monitoring and Analysis

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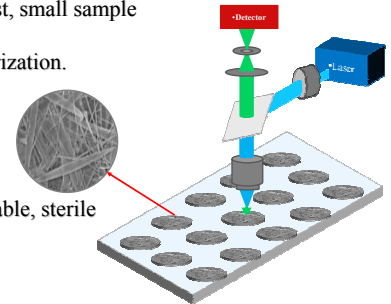
### Introduction: Sensitivity Improved Marine Biology Research Using Lab on a Chip

#### Motivation

- Elucidate cause of toxin production by algae
  - **Pseudo Nitzschia, one type of algae that produces the toxin Domoic Acid (DA):** When transferred through the food chain causes sickness and mortality in marine mammals and seabirds
- **Chip based algal culture:**
  - Culture a small number of algae and screen for factors inducing toxin production.
  - A combinatorial mixer that expose algae to different conditions at once.
  - Chip to trap a limited number of algae cells - Single cell or group of cells
- **Ultrasensitive detection of DA:**
  - Algae cells are lysed and DA is extracted for detection
  - Current detection is limited to at least 100 algae cells.
  - By using the ultra sensitive sensor toxin from 10 and less algae will be studied.

#### Advantages of lab-on-chip systems

- Batch fabricated, low cost, small sample volume.
- Automation and miniaturization.
- Can be integrated with wireless networks
- Enable multiple parallel experiments.
- Field deployable, disposable, sterile
- High sensitivity detector

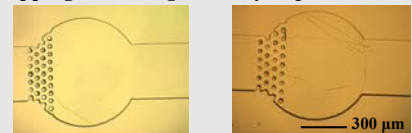


### Algae Culture on a Chip: Screening for Factors that Induce Toxin Production

- Expedite research in marine biology using chip-based technology
- Combinatorial mixer: expose algae to various condition at once
- Culture chamber: contain and culture algae
- Single or group of cells
- 3-D microfluidic chip fabricated by multilayer parylene C surface micromachining process

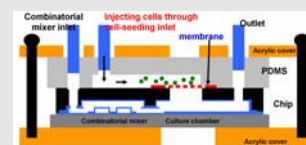
Culture chamber: contain cells using different trap geometries

#### 1) Trapping cells using an array of posts

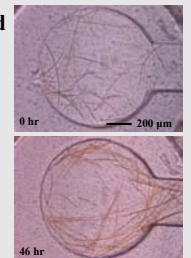


Low concentration (left) and high concentration (right) of PN cells were trapped

#### 2) Trapping cells using integrated membrane



- Cells are trapped by membrane (polyester)
- 0.4 or 1 um pore size
- More efficient cell loading



Growing Pseudo-Nitzschia inside the chambers

Replace several culture experiments with a single chip

Fabricated 1 cm by 1 cm chip on silicon

Assembled device

Combinatorial mixer operated at 10  $\mu\text{L}/\text{min}$ . The scale bar represents 1 mm.

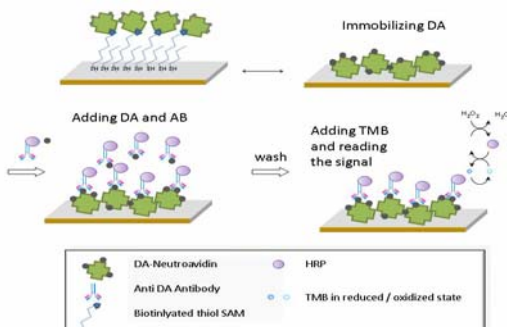
New chip on glass substrate

### Toxin Detection: Ultra Sensitive Detection Method to Monitor DA Concentration

With proper surface molecular modifications, we have developed a very sensitive electrochemical sensor for detecting both protein and RNA/DNA

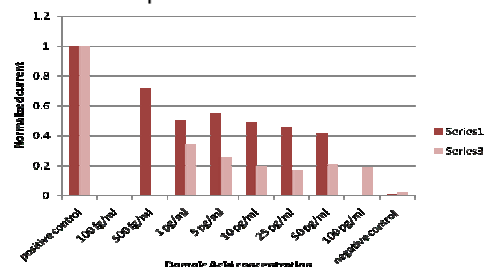
• Advantages of electrochemical sensor:

- 1- only simple micro electrodes are needed
- 2- No need for the expensive optical components or microscope.
- 3- Only 2  $\mu\text{L}$  of sample is needed.
- 4- easy current read-out, no need for optical signal survey across a surface.
- 5- small foot print and field deployable.



#### Assay

1. Immobilizing 4  $\mu\text{L}$  of 5  $\mu\text{g}/\text{ml}$  of Da-BSA on surface
2. adding 400X diluted Ab (0.25  $\mu\text{g}/\text{ml}$ )
3. Adding 2  $\mu\text{L}$  of different concentrations of Da
4. Read output current



• Current result:

Domoic Acid can be detected up to 10  $\mu\text{g}/\text{ml}$ .

• Future work:

Optimize the assay for repeatability and sensitivity.

Lyse Pseudo Nitzschia and extract DA.

Detect DA from the extract.