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THE UNIVERSITY of NORTH TEXAS
HEALTH SCIENCE CENTER at FORT WORTH

Ultrasensitive SPCE technology for early detection and prevention of CVD for underserved and minority populations.

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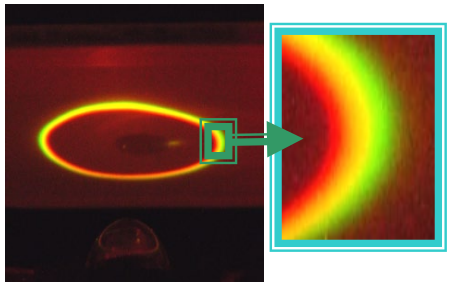
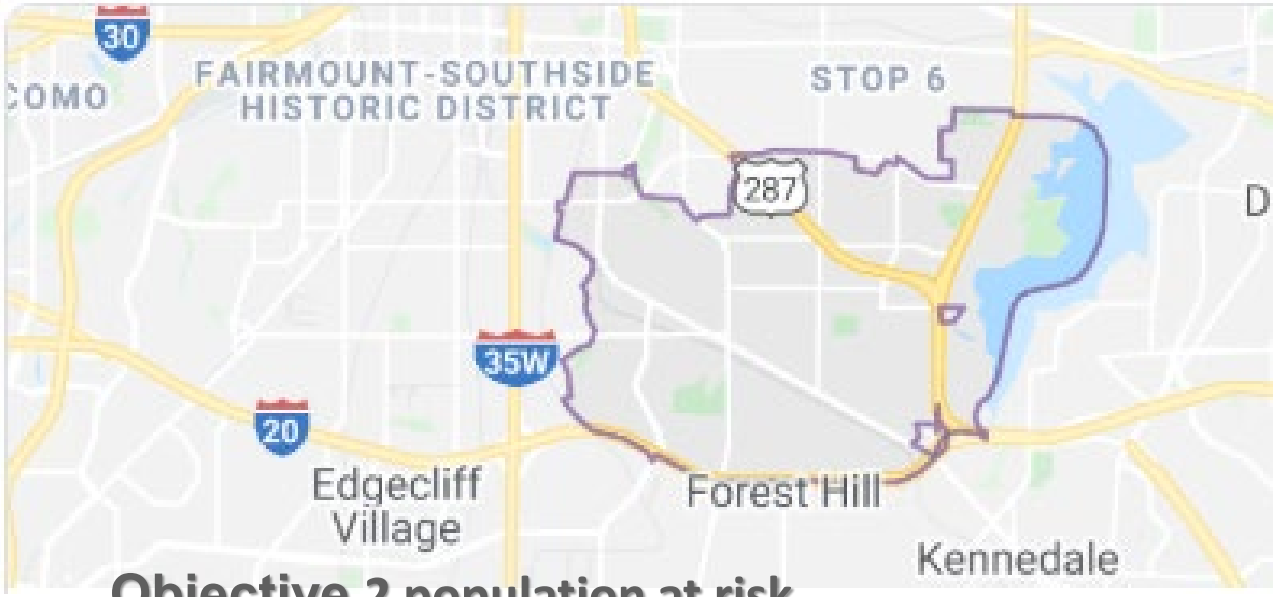
Objectives

Objective 1 SPCE

In each of the four major cardiovascular disease (CVD) categories (e.g. coronary artery disease; ertension, stroke, and congestive heart failure), can American (AA) women have greater mortality n white women.





Objective 2 population at risk

Significance

- About **7.6%** of African Americans, 5.8% of all White women and 5.6% of Hispanic women have coronary heart disease.

- Underserved minorities and individuals living in under-resourced communities lack access to comprehensive care, due to critical gaps in availability of advanced medical technologies.

- The development of a cost-effective medical technology that will be accessible to low resourced health care settings and that will allow for the early and fast detection of CVD biomarkers known to predict CVD and early heart attack risks in Tarrant County, TX.

- Development of new platform technology and assay for a diagnostic assay (cTnI, Myoglobin and CK-MB) that is particularly significant for acute medical care.

Innovation

1) Public health innovation:

- Cost-effective, simple to use, and available to underserved communities.
- Transforming prevention among underserved minority populations through access to high-throughput screening diagnostic tests.

2) Technical innovation:

- SPCE phenomenon in a fluorescence detection device.
- The sensitivity of a constructed apparatus will be at least an order of magnitude greater than existing devices.

3) Assay design.

- It will drastically increase specificity by eliminating unwanted sample background.
- It will allow very effective high throughput screening for ultrafast sample analysis.

Objective 1.

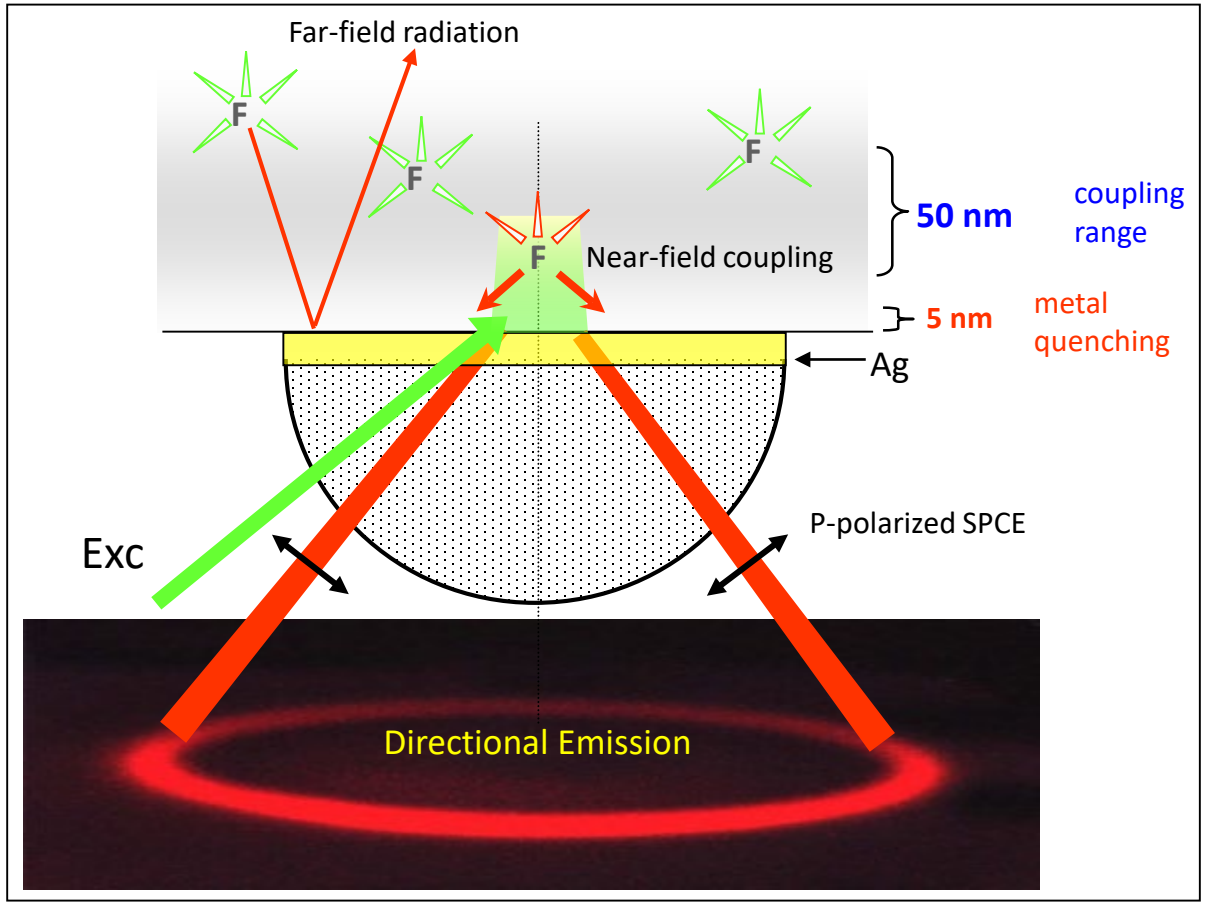
Design and test Surface Plasmon Coupled Emission system

Our major goals are:

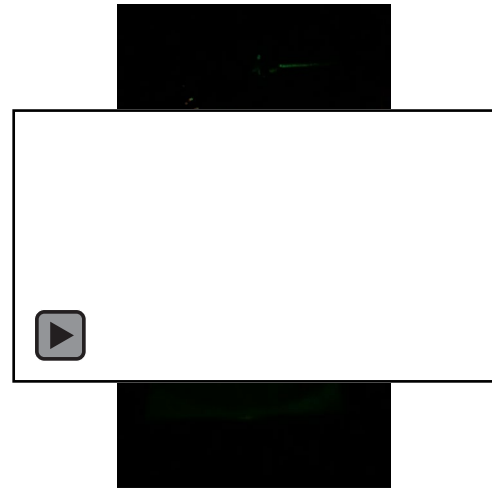
- construct a robust prototype of SPCE-based apparatus,
- develop protocol for selected surface assay including cTnI, Myoglobin and CK-MB biomarkers.

Background

SPCE (Surface Plasmon Coupled Emission) – Theoretical concept



The excitation energy of the fluorophore couples to the surface plasmons and radiates to the glass prism in the form of a directional ring. Far-field radiation is reflected by the metal surface.



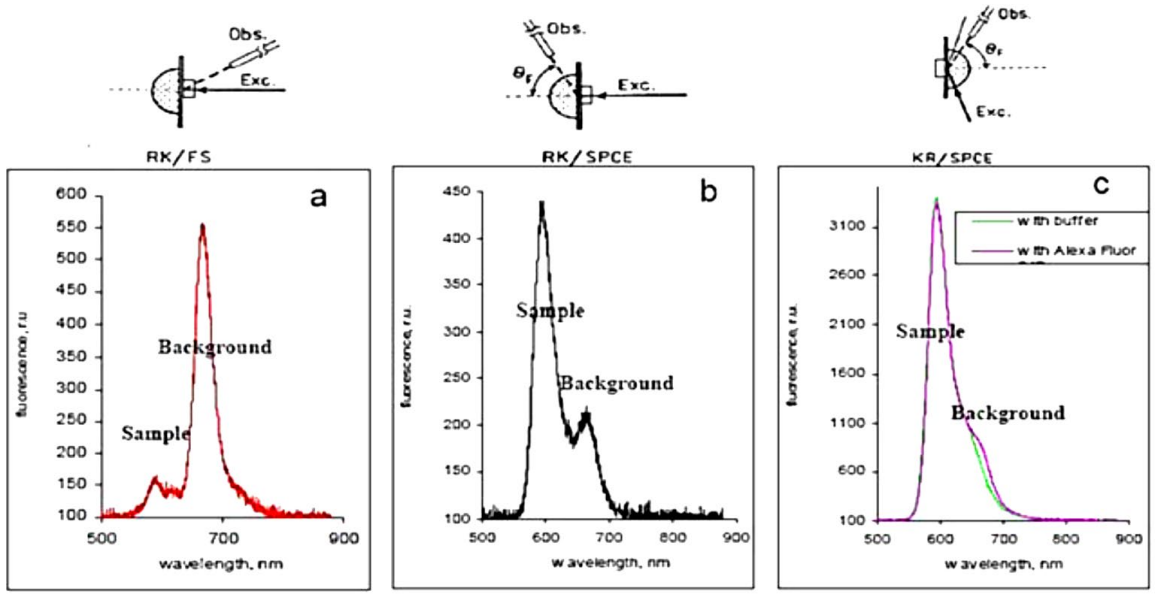


***Figure 1**. Observed fluorescence with a) free space emission with reverse Kretschmann excitation mode b) SPCE with reverse Kretschmann excitation mode and c) SPCE with Kretschmann excitation mode.*

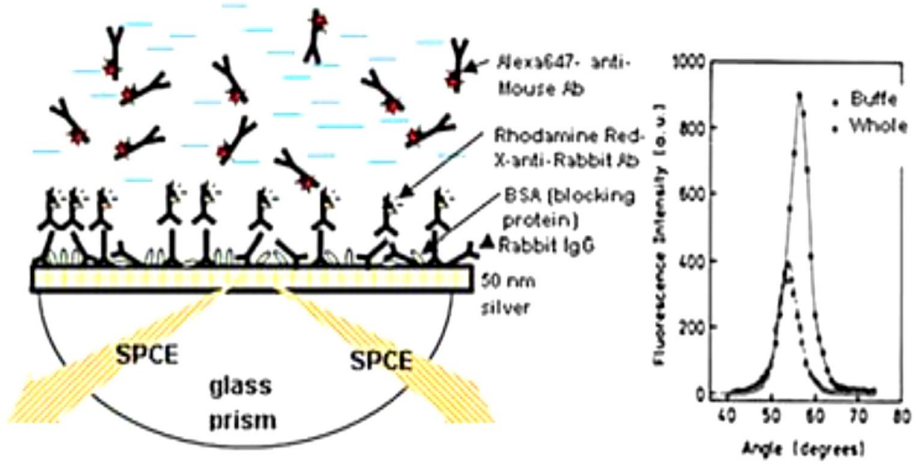
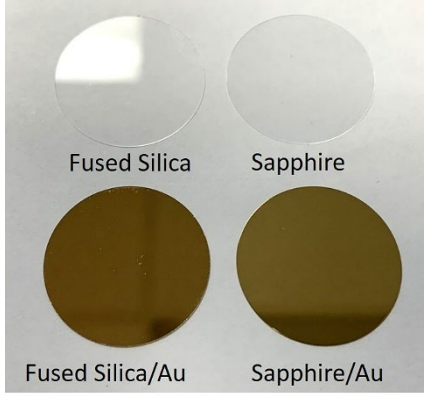
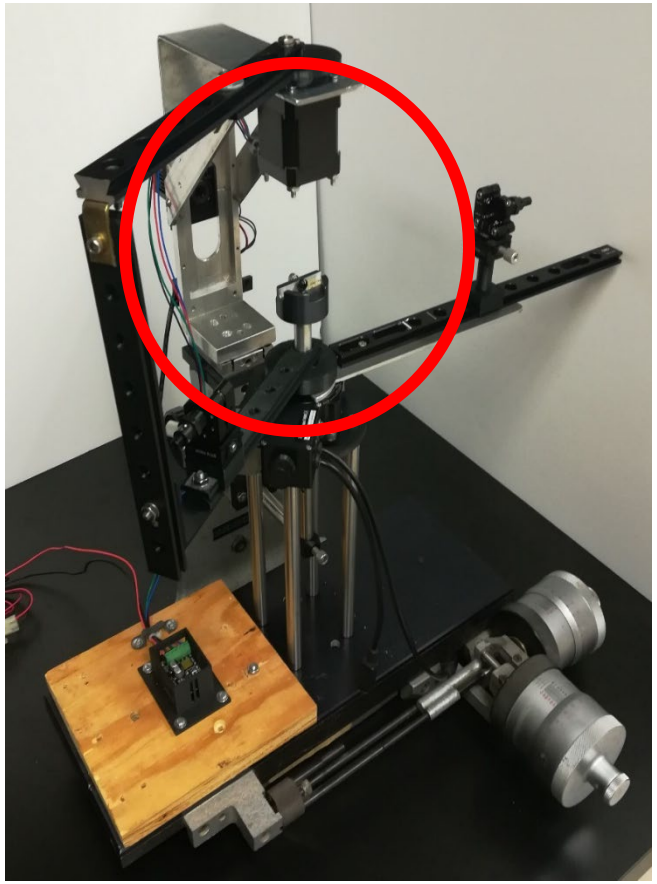
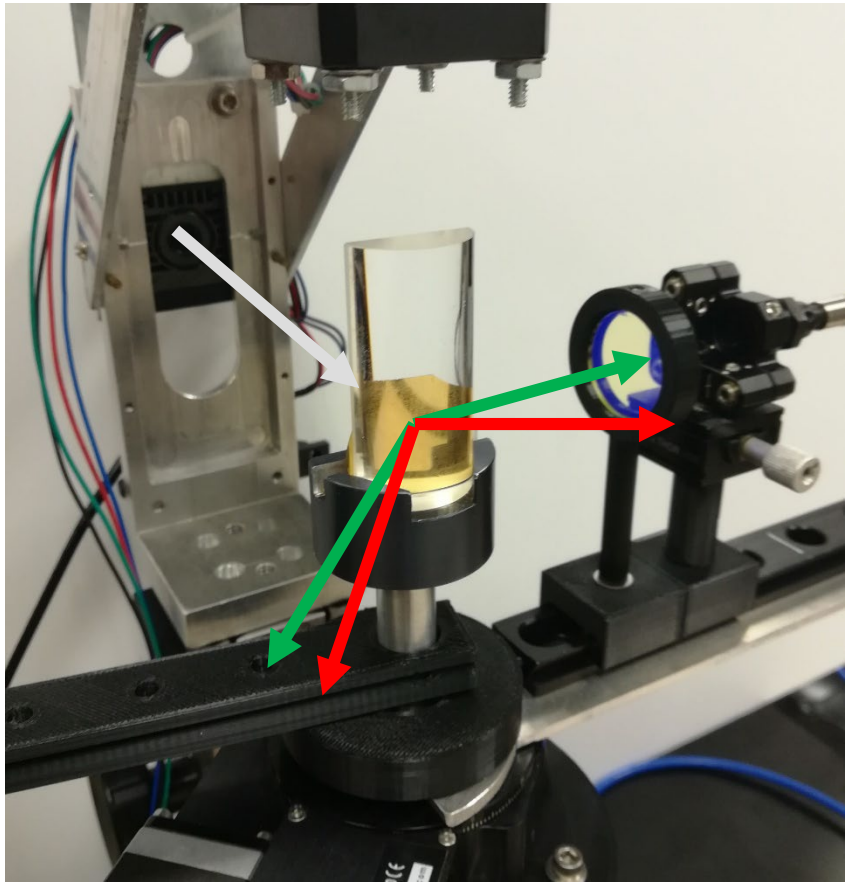


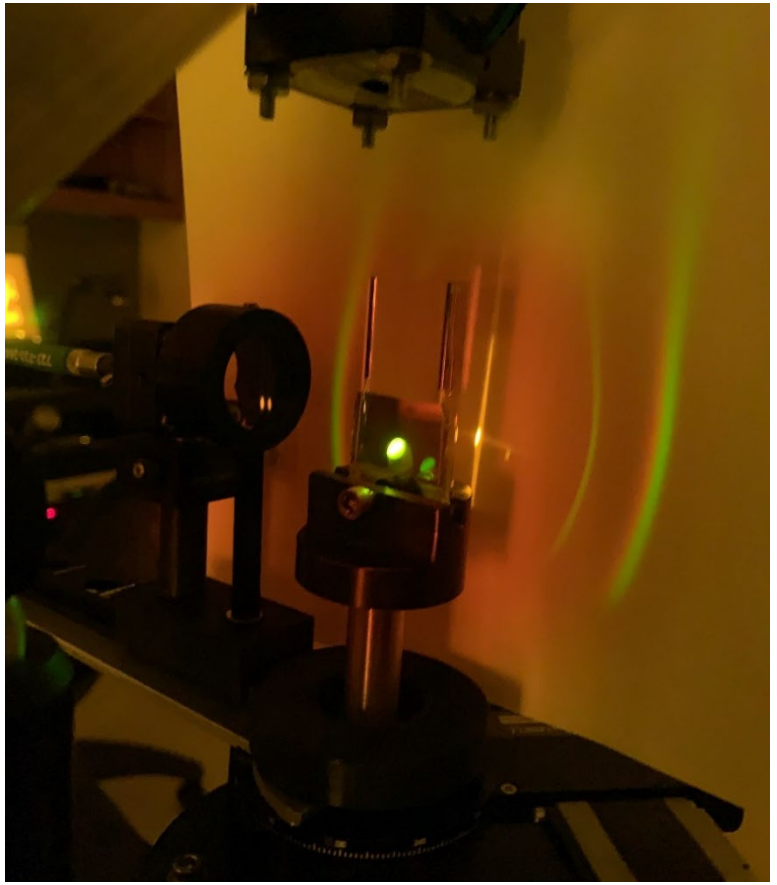
***Figure 2.** The shame of SPCE immunoassay (left). The angle dependent intensity observed through the prism with SPCE angle measured with buffer and whole blood.*

SPCE experimental setup. Testing unit









Objective 2.

To **assess** the need and benefit of such technologies within underserved communities

- We considered all patients within the DFW Metroplex
  - 5 county region (Collin, Dallas, Denton, Rockwall, and Tarrant).
- Looked at all patient with a primary or secondary diagnosis of Congestive Heart Failure. (n=80,653) in 2017
  - Considered all patients who died, either in a hospital or hospice (n=6,180).

Cardiac Disease in DFW Metroplex Results:

- African-Americans had the shortest lifespan (69.0) of any group in the Metroplex.
  - White females lived 8.2 years longer than AA females and 10.4 years longer than the Hispanic females
  - The zip code within Tarrant County with the highest number of AA deaths was zip code 76119. Within zip code 76119 55% of all deaths were African-American.

Table 1. Dallas-Fort Worth Life Expectancy (n = 5,647)

	Female	Male	Overall
African-American	72.1	65.7	69.0
Asian	79.3	75.5	77.5
Hispanic	69.9	72.6	71.3
White, Non-Hispanic	80.3	76.4	78.3

Table 2. Reduced Years of Life, Compared to Max

	Female	Male	Overall
African-American	8.2	10.7	9.3
Asian	1.0	0.9	0.7
Hispanic	10.4	3.8	7.0
White, Non-Hispanic	0.0	0.0	0.0

Zip code 76119

- Median Income = $28,660 compared to $64,874 in Tarrant County
- 47% of persons age 18-64 do not have health insurance.
- 15.2% of children do not have health insurance.
  - Source: www.towncharts.com/Texas/Healthcare/76119-Zipcode-TX-Healthcare-data.html
- Residents of this zip code had more than double the number of ER visits compared to the average for Tarrant County.
  - 3,450 vs. 1,720 per thousand patients.
  - Source: Emergency Room Visits in North Texas

Closing Statement

- We believe that this new platform/assay we are developing will help reduce barriers of African American women in early CVD diagnosis and ultimately lower the CVD-related deaths in Tarrant County as well as nationally.
- This novel technology will be useful for the identification of currently unknown biomolecule signatures of CVD.
- **Our long term goal** is to place our technology to target specific populations within Tarrant County that would be most likely to benefit from this early intervention to identify and prevent heart disease.

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