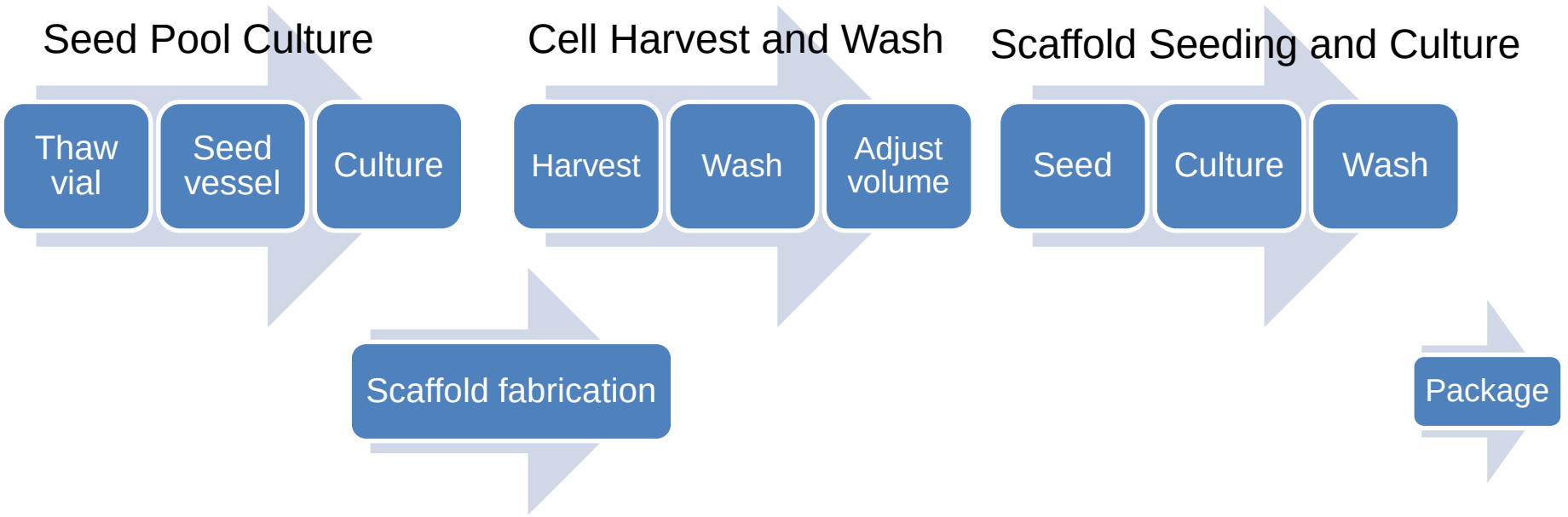
Developing Next Generation Biosensors

TEMP Sensing Needs



Ensure purity of raw supplies

Cell identity

Cell viability

Growth factors

Lipids

Cell confluence

Metabolites

Proteins

Types of Measurement

In-line/at-line

- Rapid results
- But not as much information

Two main types

- Optical measurements
- Using biological recognition elements
  - Ex. antibodies
  - “biosensors”

Off-line

- Can obtain excellent specificity and sensitivity
- But can take days to get results and can be expensive

- Western blott
- Mass Spec (MS)
- liquid chromatography (LC/HPLC)

In-line / At-line Measurements

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Optical Measurements

Raman
FTIR
Optical coherence tomography
Imaging
Other spectroscopy

Tends to not need sampling
Can be reused
Specificity is a challenge

Biosensors

Uses a recognition element:
antibody, aptamer, ….
Different detection methods
- electrochemistry
- optical
- resonance frequency

Specific detection
Requires sampling
Most disposable, but some ideas to make it reusable

No sensor is fully non-invasive, so we seek for minimally invasive in a way that isn't significant for our use.

Example of Biosensor - LightSense

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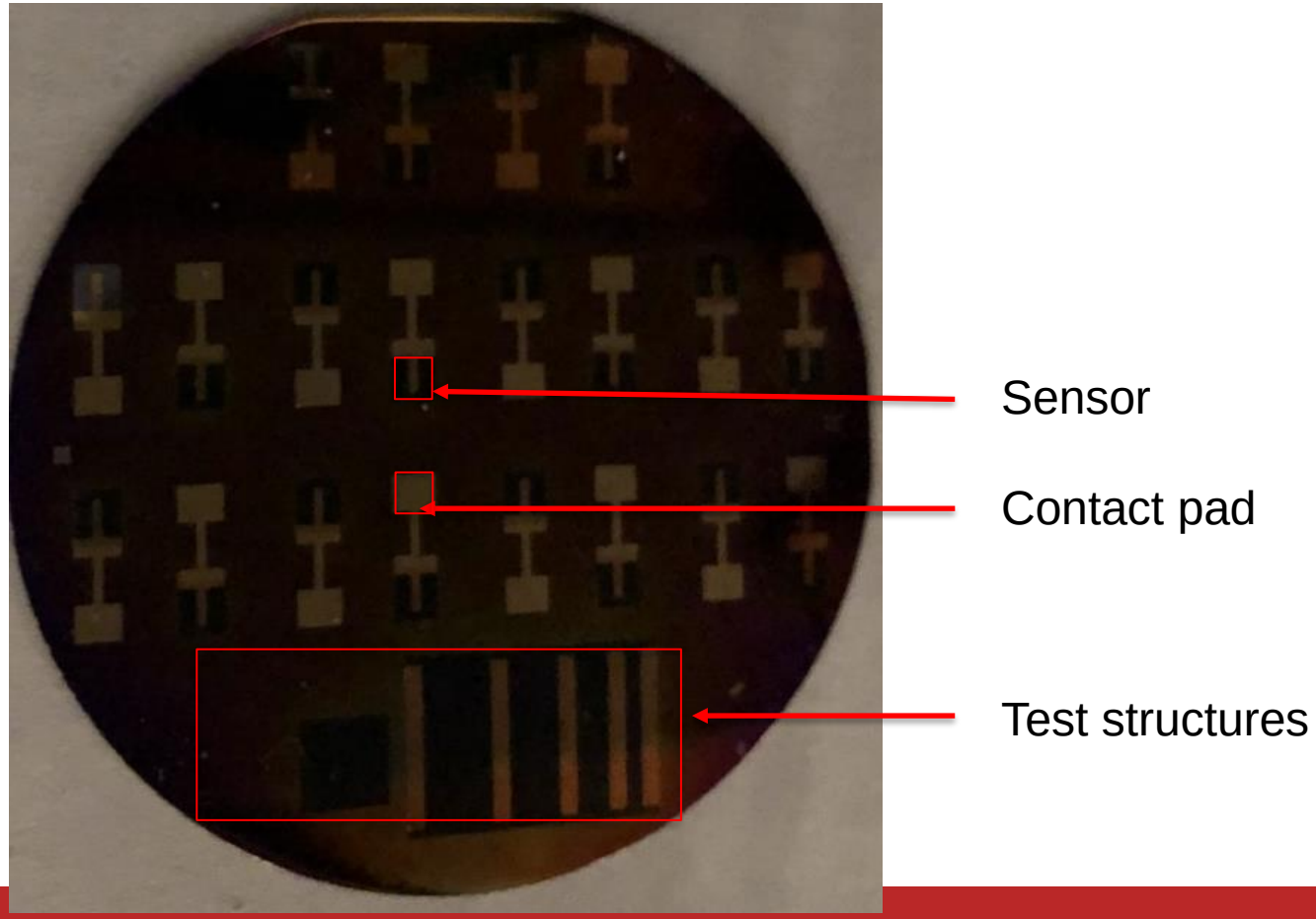
- Biosensors can be made very small, so that there is minimal perturbation to the chamber



Antibody/Protein Based Sensors

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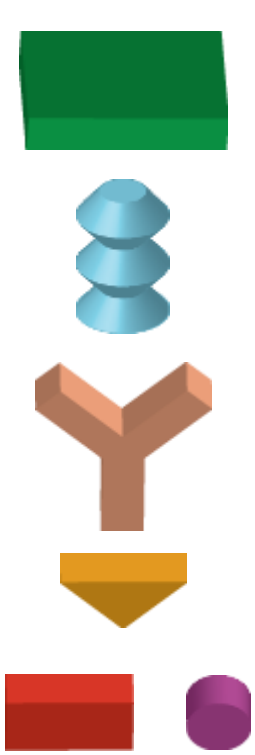
- Three main steps: expose to solution, rinse, and measure
- Antibody is specific to protein



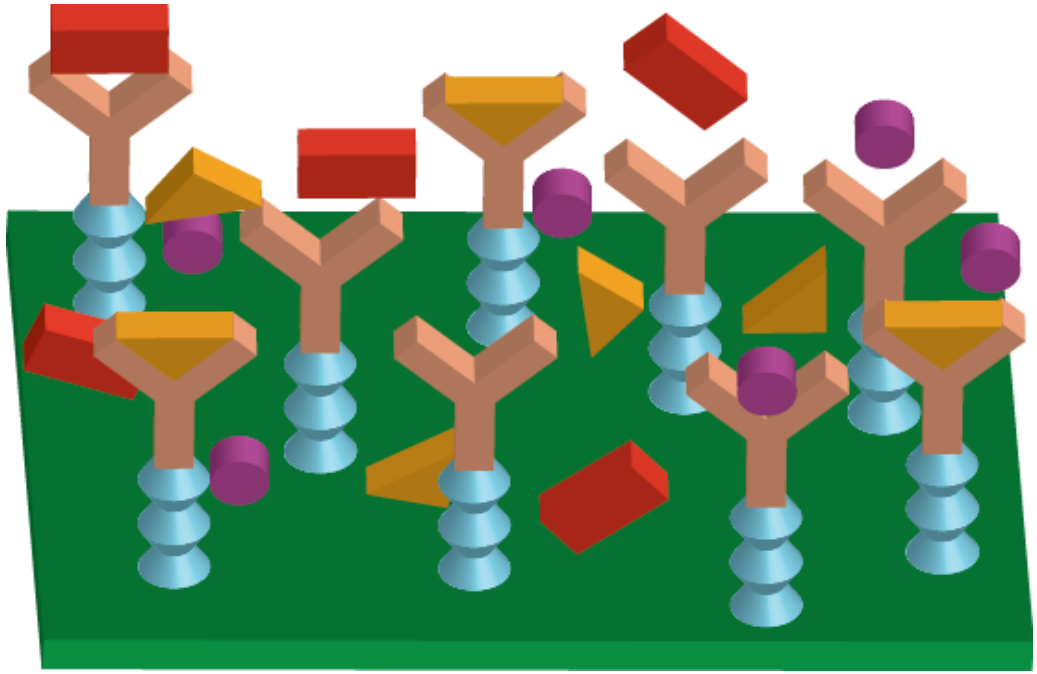
Silicon surface

APTES

Antibody

Protein of interest

Other proteins



Silicon Nanowire LightSense

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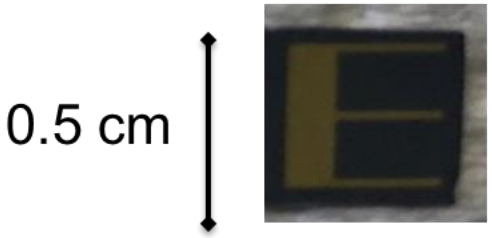
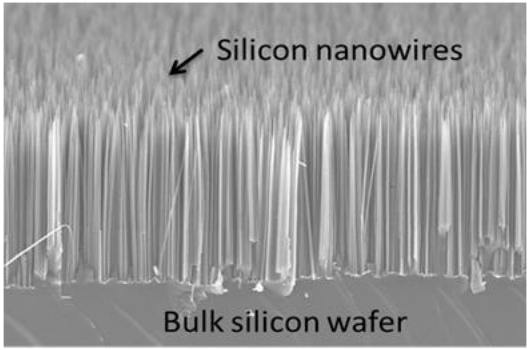
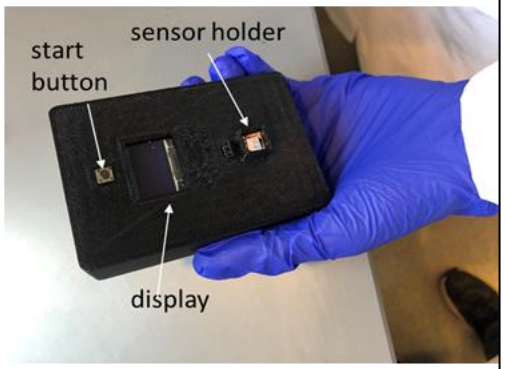
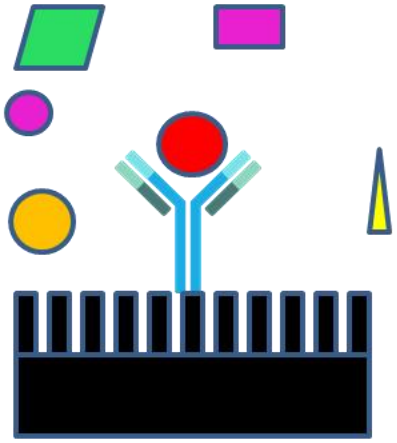
ASG's Sensor

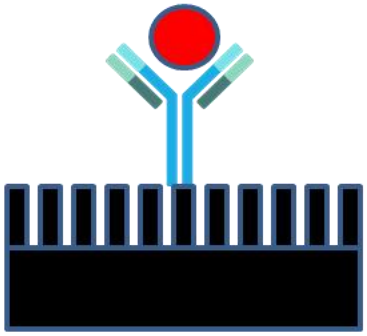




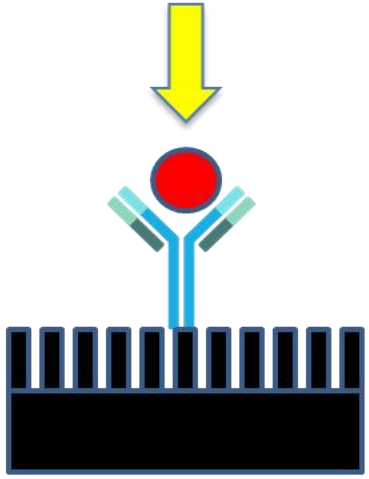




Add sample



Rinse



Measure

Nanowire Sensors Lead to Increased Protein binding

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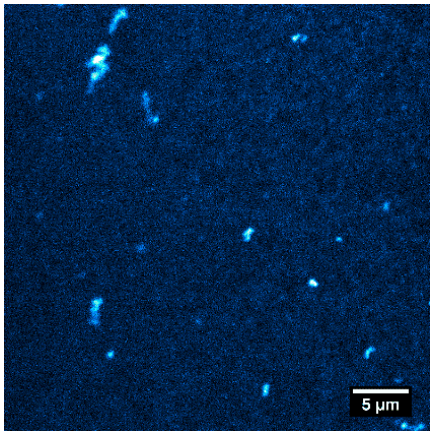
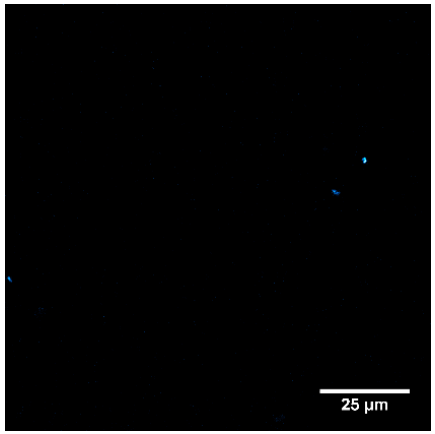
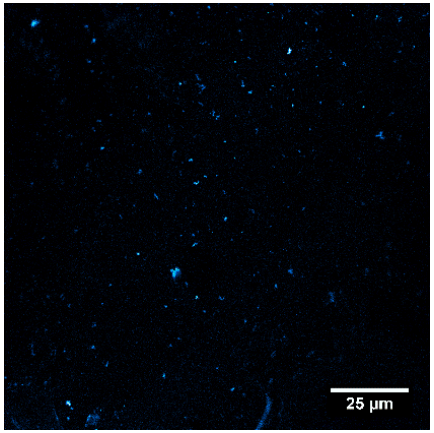


Nanowire Functionalized

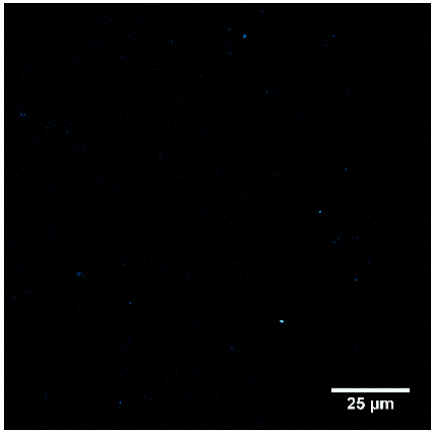


Nanowire Unfunctionalized

Nanowires show increased binding



Planar Functionalized



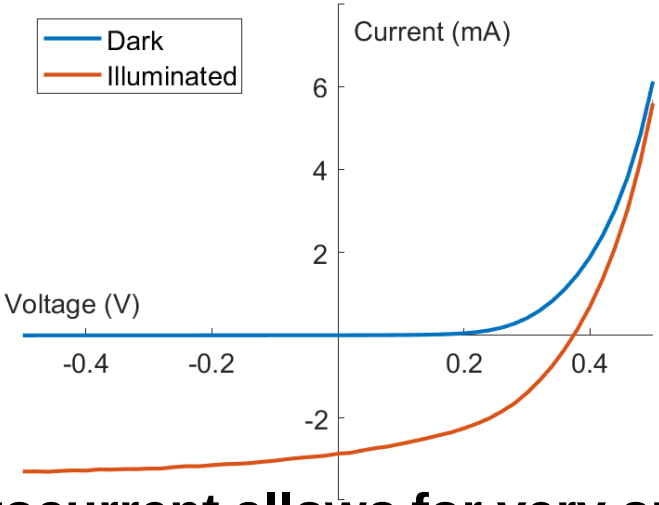
Planar Unfunctionalized

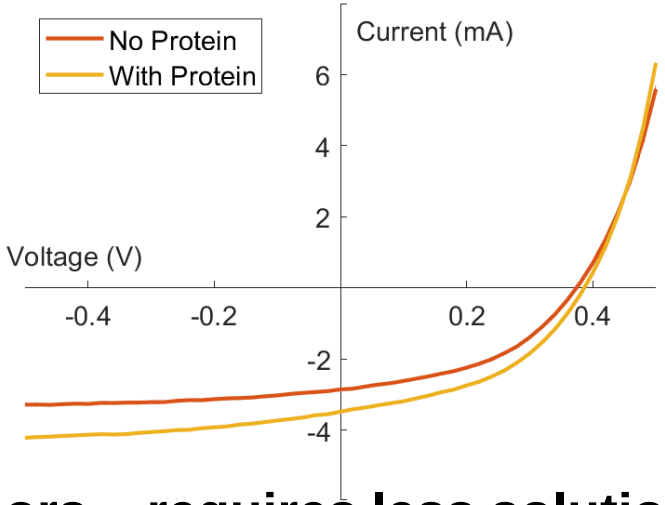
Blue – antiPSA

Scale bar 5, 25, 25, 25 µm

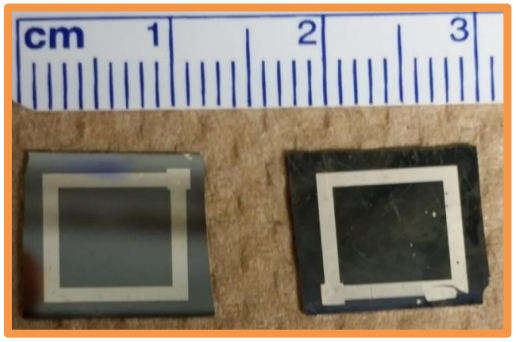
How Photoelectric ELISAs Work

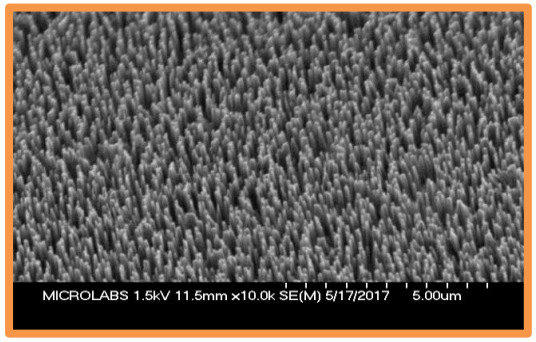
The change in photocurrent is used to tell users the concentration of protein in their solution

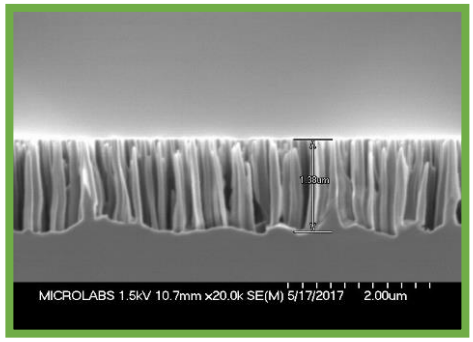




Photocurrent allows for very small sensors – requires less solution and lower cost







Technological Advantages

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- Electrical measurements are preferred to optical
  - Lower cost
  - Much more sensitive
- Silicon preferred
  - Can easily multiplexed by using knowledge from the semi industry
  - Can be scaled
  - Low cost since antibodies dominate cost and they can be very small
- Improve lower limit of detection with nanowires
  - High surface area to volume ratio
  - Low cost process
  - Used in football fields of solar cells

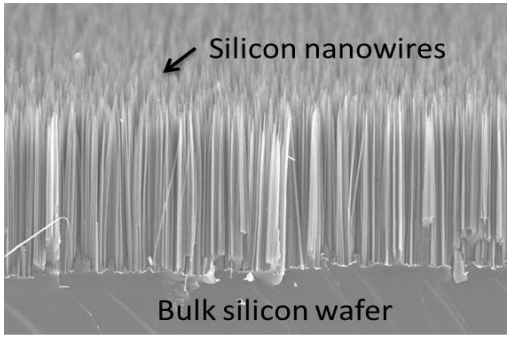
ASG's Photo Electric ELISA

ASG's Sensor

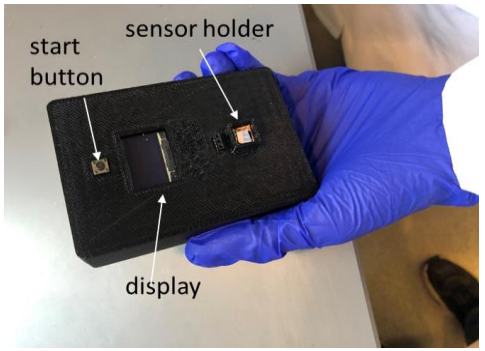
0.5 cm

Silicon nanowire sensors
- consumables

We work with you to develop a sensor for your application. Then sell you consumable sensors and provide you with proprietary algorithms & software to interpret the signals and a low cost system to take measurements.



Handheld system



Technical Team

Team- 5 Technical + CMO

Marcie Black, CEO
- Los Alamos, Motorola, Bandgap Engineering
- PhD MIT, electrical engineer

Nguyen Le, Biochemistry Engineer
- Silicon nanotube biosensors
- PhD TCU Chemistry, BS Biochemistry

Sina Baghbani Kordmahale
- Optics, nanoprocessing
- PhD A&M, device and nano electronics

Celeste Bedard, Engineering Technician
- Experience processing semiconductors
- Raytheon

Nick Bateman, Director Sensor Development
- Principal Scientist, Applied Materials
- PhD Yale, BS MIT physics

Bill Rever, Chief Marketing Officer
- 25 years of marketing and sales experience
- BP Solar

Conclusion

- Lowering the barriers for protein sensing will bring us benefits in many fields including TEMP.
- Our sensor (LightSense) has unique advantages for protein sensing
- Well suited for low-cost, rapid, multiplexed detection of proteins
- We want to work with you to help you develop sensors for your application so we can both win.
- Improved biosensors for TEMP are coming soon!

ASG has Secured $3M+ in Non-Dilutive Funding

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NSF

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

UNITED STATES AIR FORCE

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Massachusetts LIFE SCIENCES CENTER
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Massachusetts Medical DEVICE DEVELOPMENT CENTER