# ATTACHMENT OF GOLD NANOSPHERES TO SILICON DIOXIDE VIA HGH/ANTI-HGH SYSTEM


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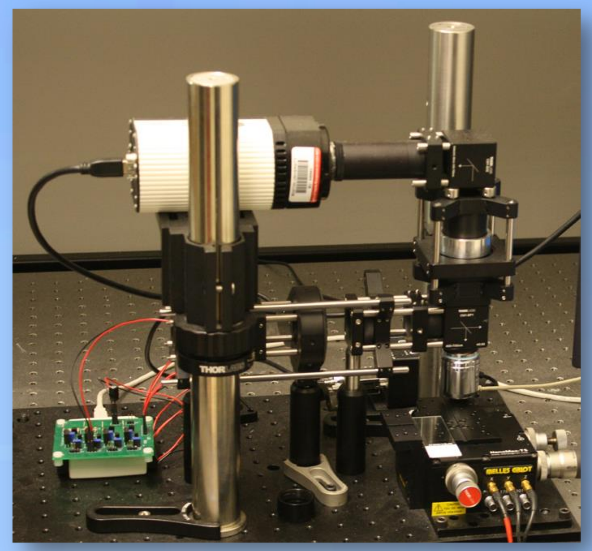
## IRIS: Interferometric Reflectance Imaging Sensor



The IRIS measures nanoscale differences in thickness using the principles of light wave interference. An LED emits light at a known wavelength which is then directed towards a dual-layer chip. Some light reflects off of the top of the chip, while the rest reflects off of the bottom layer. All light is directed to a sensor which measures the amount of interference. The degree of interference is dependent on the difference in the optical path length, and so analysis of the interference pattern will yield information on the height of the sample bound to the chip.


## Abstract

The rapid identification of viruses allows doctors to treat patients with high rates of success. The Interferometric Reflectance Imaging Sensor (IRIS) is a high-throughput, label-free antigen detection system. Gold nanospheres with a mean radius of 40 nm were coated with anti-HGH, and then incubated with a silicon dioxide chip functionalized with HGH. Nanoparticles were identified on the HGH chip, but not control chips, by the high-magnification IRIS system. Future work with the system should focus on the refinement of chip cleaning protocols and procedures which enable IRIS to differentiate between virions based on shape as well as size.


## Procedure

**Chip Preparation**

- 100 nm $SiO_2$ thickness
- Polymerized with DMA-NAS-MAPS
- Rinsed in DI water
- Coated with Antigens: HGH, BSA, IgG
- Rinsed with PBST, PBS, and DI water

**Bead Preparation**

- 40 nm carboxylated gold nanospheres
- Add succinimide terminal with EDC/NHS solution
- Attach antibody (anti-HGH) in PBS

**Incubation**

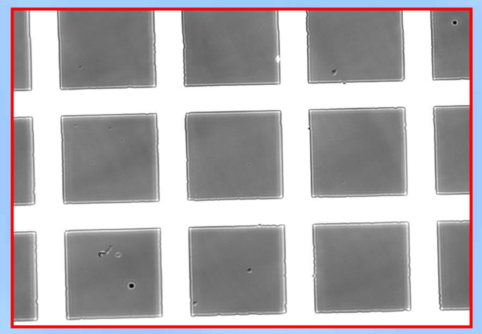
- Dilute beads in PBS
- Incubate on shake table for 2 hours

**IRIS**

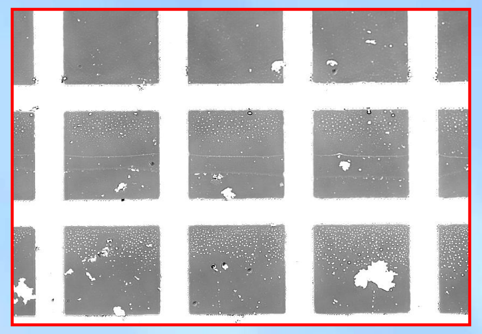
- Image selected areas of chips
- Software analysis of images to detect surface attachment of gold spheres

## Data

HGH Chip

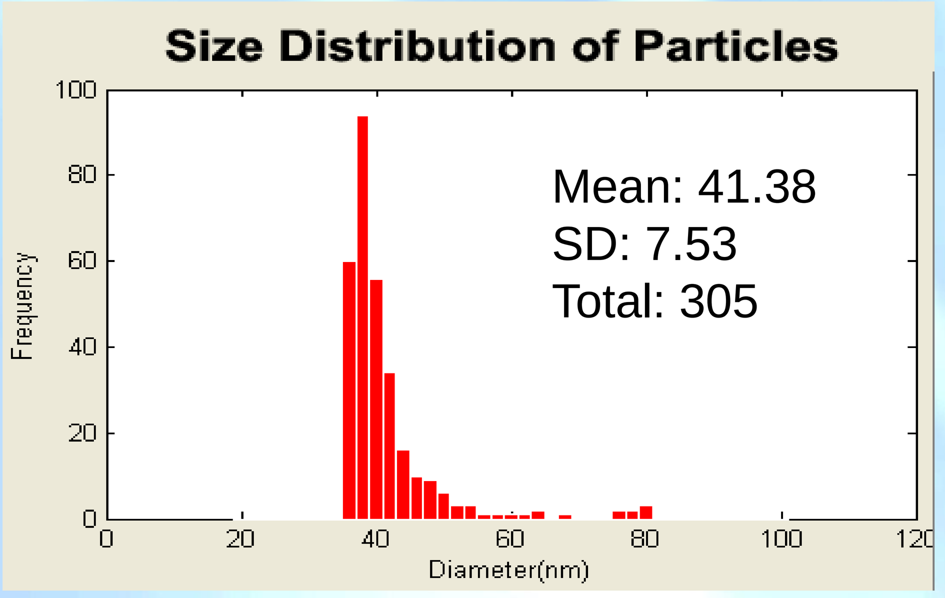


Before Incubation



After Incubation

Upwards of 300 beads were detected on the chip coated with HGH, whereas no beads were detected on the chips coated with IgG and BSA. As expected, the beads conjugated with anti-HGH bound specifically to HGH, but not to other antigens. Additionally, IRIS was able to discriminate between the beads and contaminants present on the chip surface via manual signal processing at another workstation. Questions remain as to the nature of the small, uniform white particles which appeared on the surface of the chip.



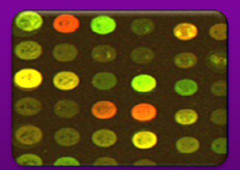

## Future Work

**Bonding Systems**

- New antigen-antibody pairs, such as BSA and IgG, should be explored for use with both nanospheres and nanorods of varying size. After these standard pairs have been explored, viral antigens would be a logical next step.

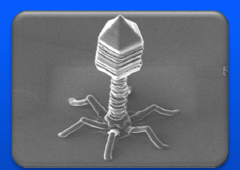
**Cleaning Protocols**

- Dirt was present on chips immediately after their preparation with proteins, despite a thorough wash. After incubation with nanobeads, the chips were even dirtier. Small particles, perhaps crystals, formed over large areas of the chip.



**Microarrays**

- The current chip spotting protocols are rarely 100% successful. Arrays commonly lack entire rows of spots, spots wash off, dry in irregular patterns, or do not exhibit the expected binding patterns when using antigen-antibody pairs.



**Particle Discrimination**

- Now that a reliable protocol for gold particle adhesion has been established, work can begin on tuning IRIS to discriminate between particles with different characteristics. Once IRIS successfully differentiates between each, trials may begin with either inactivated virions or virions which pose no threat to humans, such as VSV.

## Lesson Plan: Introduction to Light

| Step | Activity | Purpose |
|---|---|---|
| Opening | Give students 5 minutes to answer basic questions on light, then share responses. | Purpose: Assess prior knowledge. |
| Demo 1: Laser Tissue | Set a piece of tissue paper on fire with a laser. | Purpose: Connect the concepts of light and energy. |
| Demo 2: Dark Room | Turn off the lights in the room and close the blinds. Let ambient light enter, and discuss why. | Purpose: Connect how light travels with how sound travels. |
| Demo 3: Sound Propagation | Turn your back to the room and say something, then ask how students could hear you. | Purpose: Create a wave diagram. |
| Demo 4: Slinky Mechanics | Send wave pulses through the slinky in pairs to exhibit different wave characteristics. | Purpose: Introduce vocabulary and the concepts of interference. |
| Double Slit Lab | Students will replicate Young's famous Double Slit experiment with cardstock and a laser pen. | Purpose: Hands-on experience with wave interference. |
| Summary Notes | Quickly move through vocabulary and topics from the lesson. | Purpose: Norm definitions and check for student understanding of topics. |

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