



Center for
Advanced Microelectronics and
Biomolecular Research CAMBR



Nano Technology

Electronic Biosensors for Food Safety

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Electronic Applications

- High sensitivity and selectivity
- Near Real Time Detection
- Field use
 - Low cost
 - Built upon existing semiconductor infrastructure
 - Portable
- Built-in intelligence
- Communication

**Pathogen Biomarker
Capture & Amplification**

Detector Sensor

Electronic Amplifier

Micro processor

Communication Link

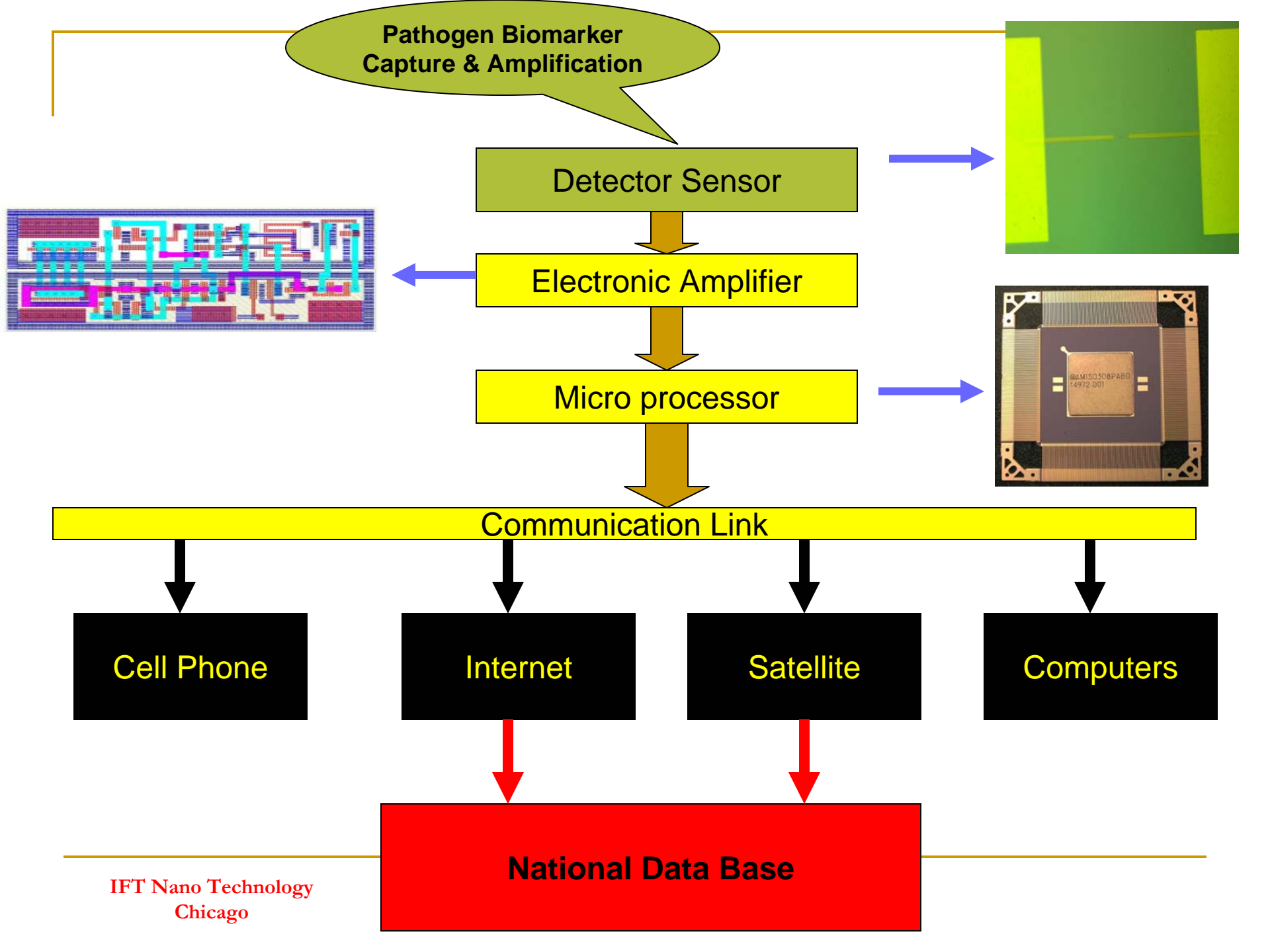
Cell Phone

Internet

Satellite

Computers

National Data Base



Bio-molecular Detection

Nanowire Field Effect Transistor

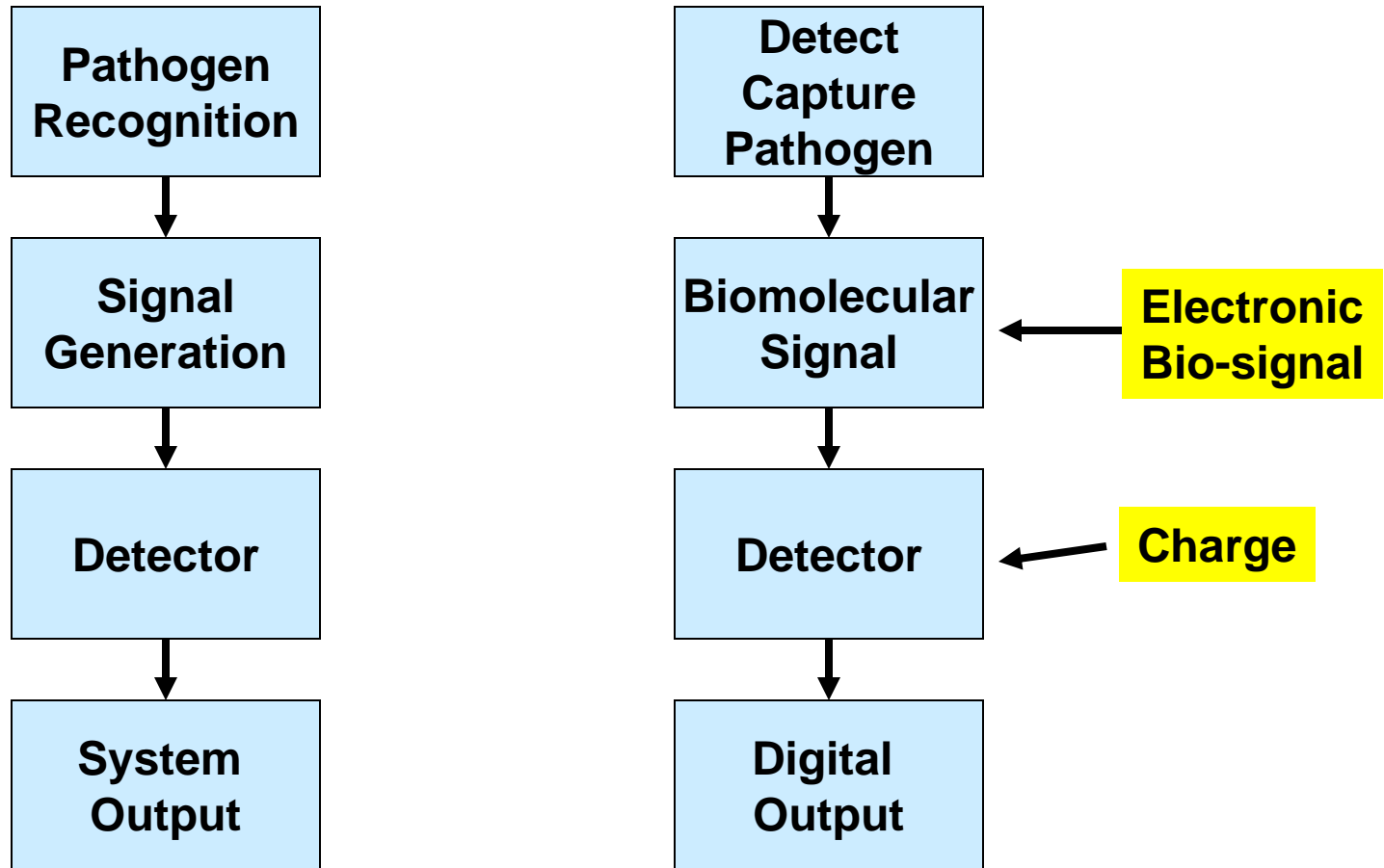
Ultra-sensitive without PCR

Label free

Simple and portable device

Low cost

Pathogen Detection System Level View



Expertise Required for Nano Detector Designs

- System level design
 - Molecular Biology
 - Nano Electronics
 - Surface and organic Chemistry
 - Deep submicron electronics
- Detector (Sensor) integrated with system elements
 - Detector sensing property
 - Electronic charge
 - Capture mechanism must produce sensing property upon capture and detection
 - Background noise reduction
 - Sensing property must transmit signal to sensor
 - Sensor device must detect signal

Problems in The Application of Nano-FET Biosensors

Complexity of surface modification for molecular recognition

- **Self-assembled monolayer**
- **Covalent linkage**
- **Spacing of capture probes**
- **Molecular orientation**

Complexity of biological sample and reaction conditions

- **The complexity of biological materials**
- **The complexity of reaction conditions**
- **Limited sensing surface area and sample volume**

Complexity of electrical properties of bio-molecules

DNA

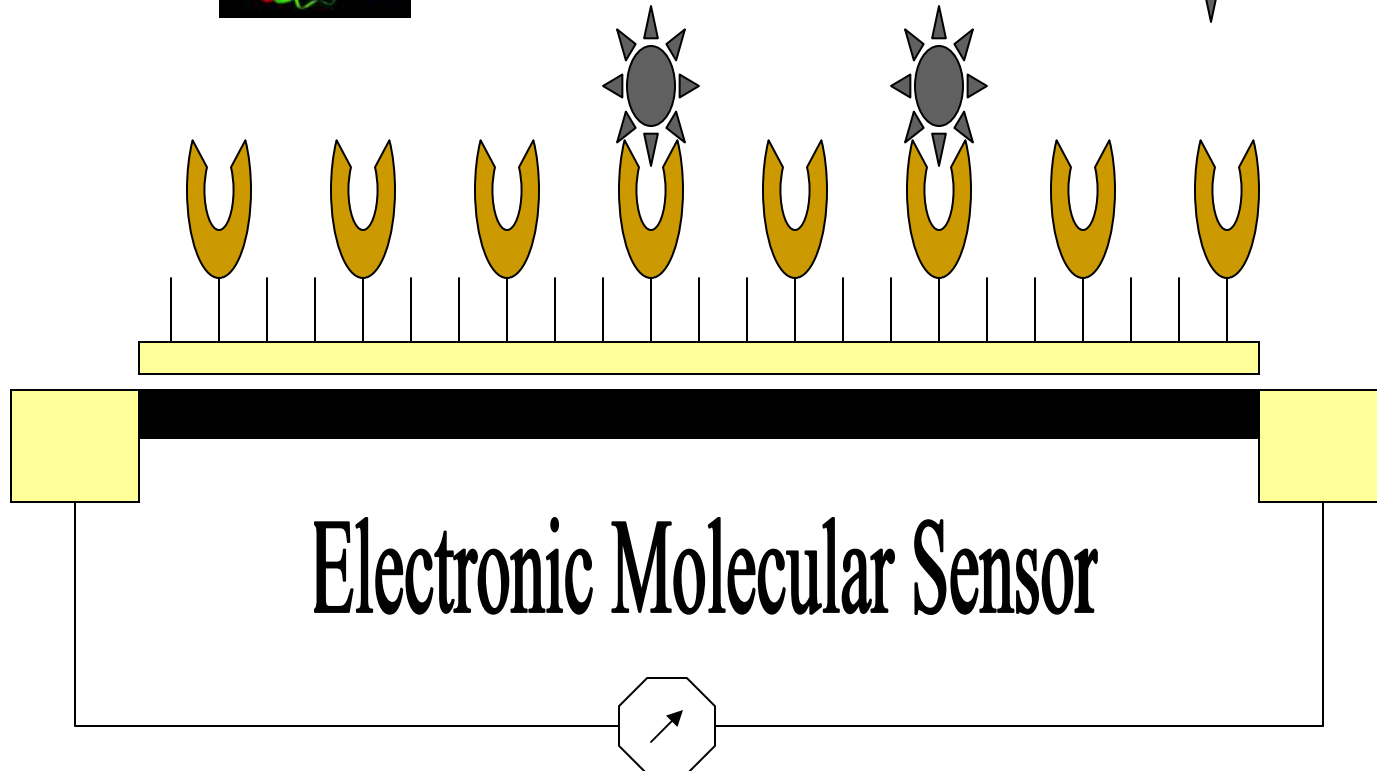


Bacterium

Protein



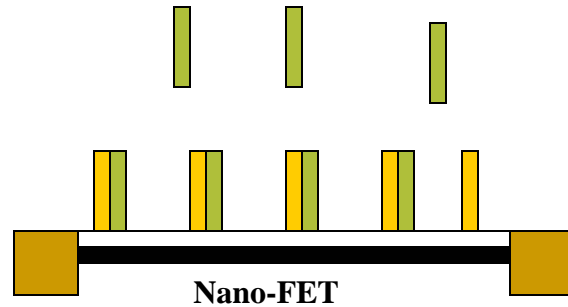
Virus



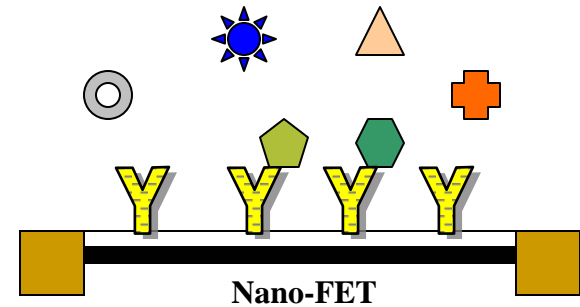
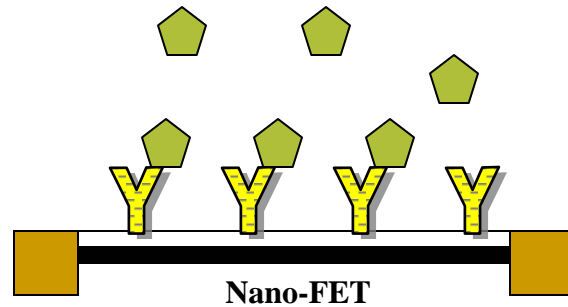
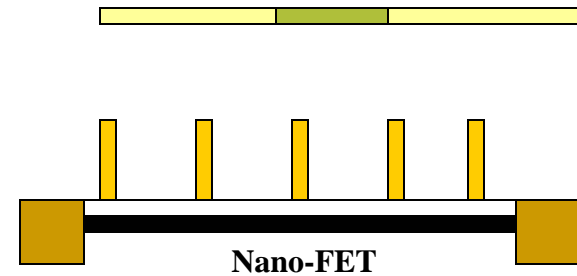
Electronic Molecular Sensor

Bio-molecular Detection on Nano-FET

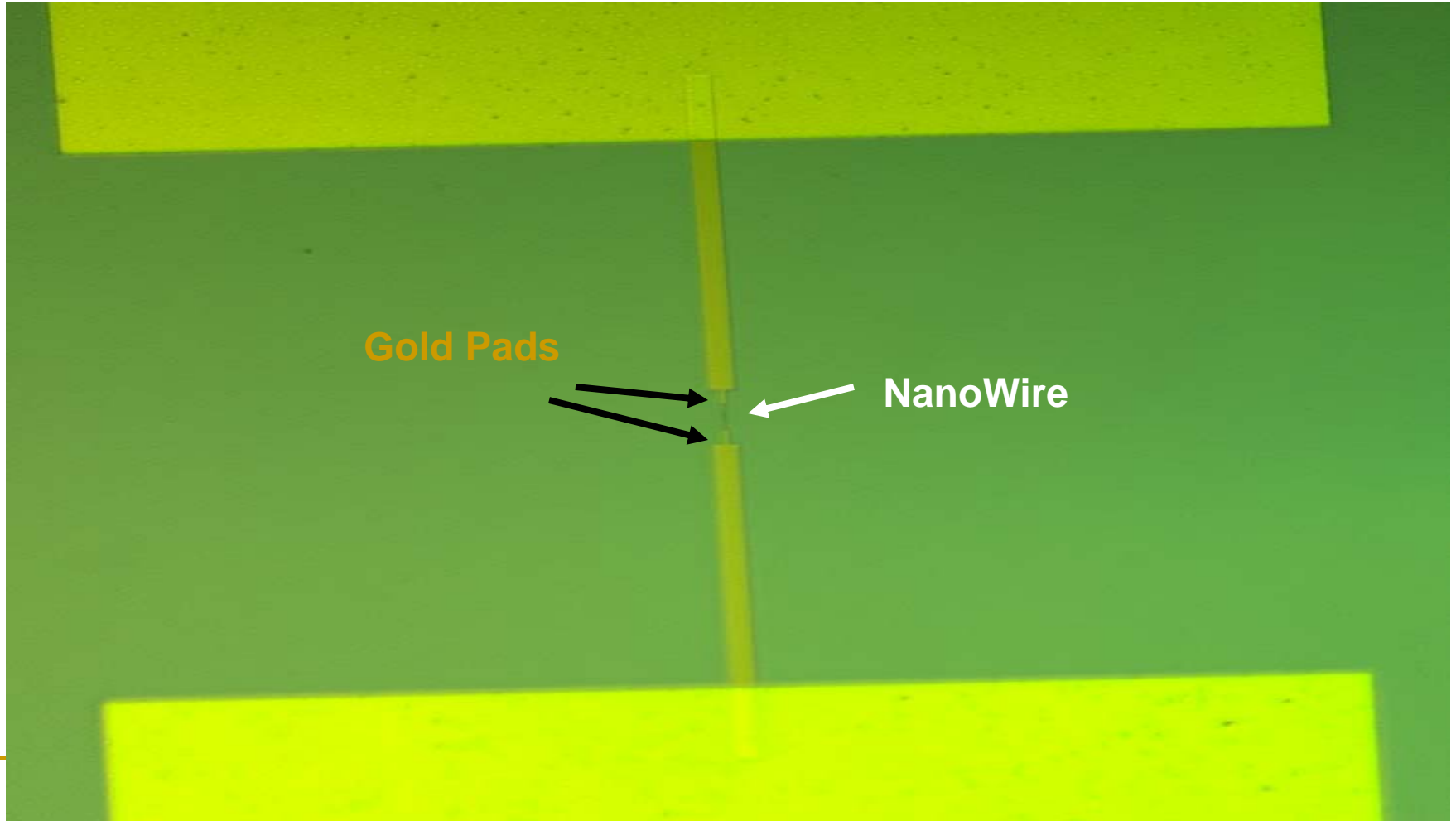
Ideal Detection



Real Detection

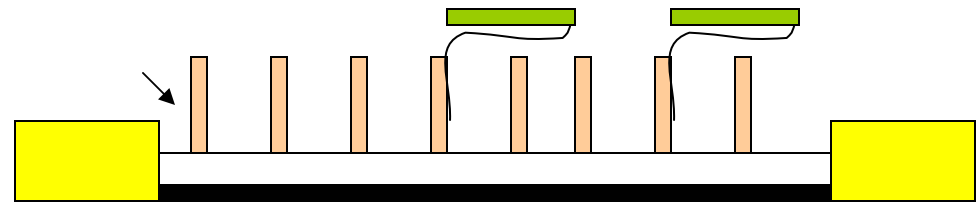
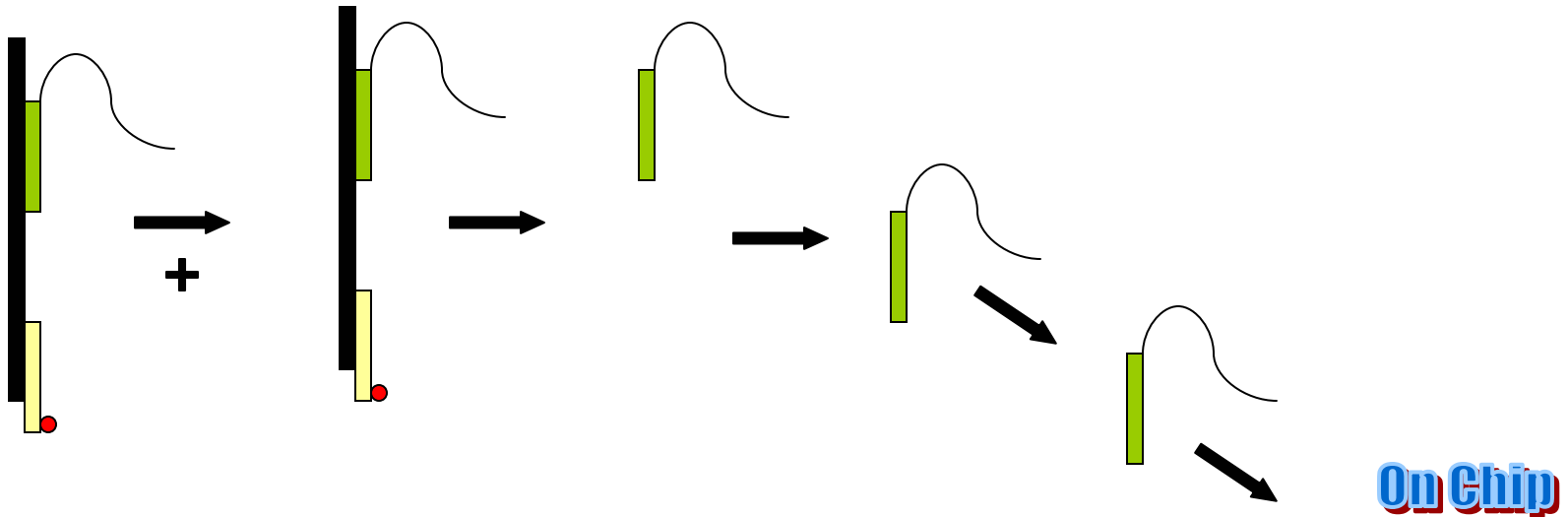


Nano Transistor



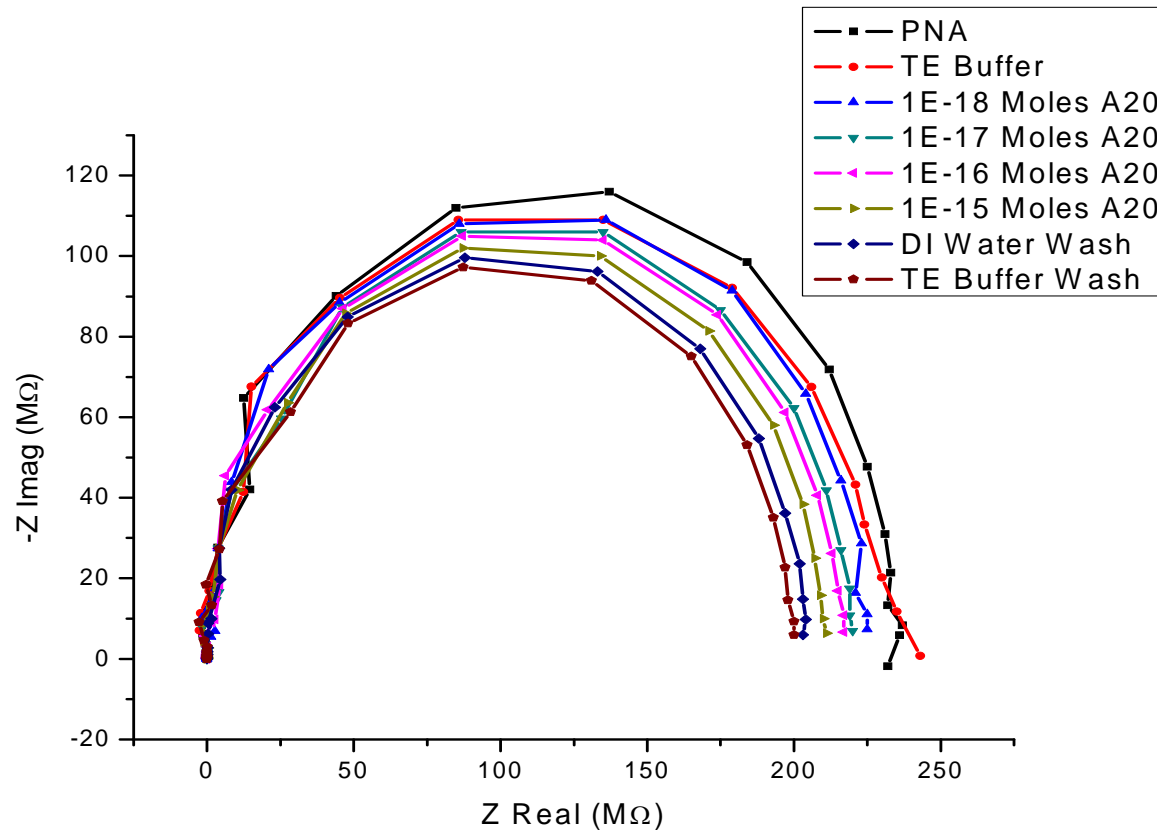
Nucleic Acid Detection Model

Off Chip

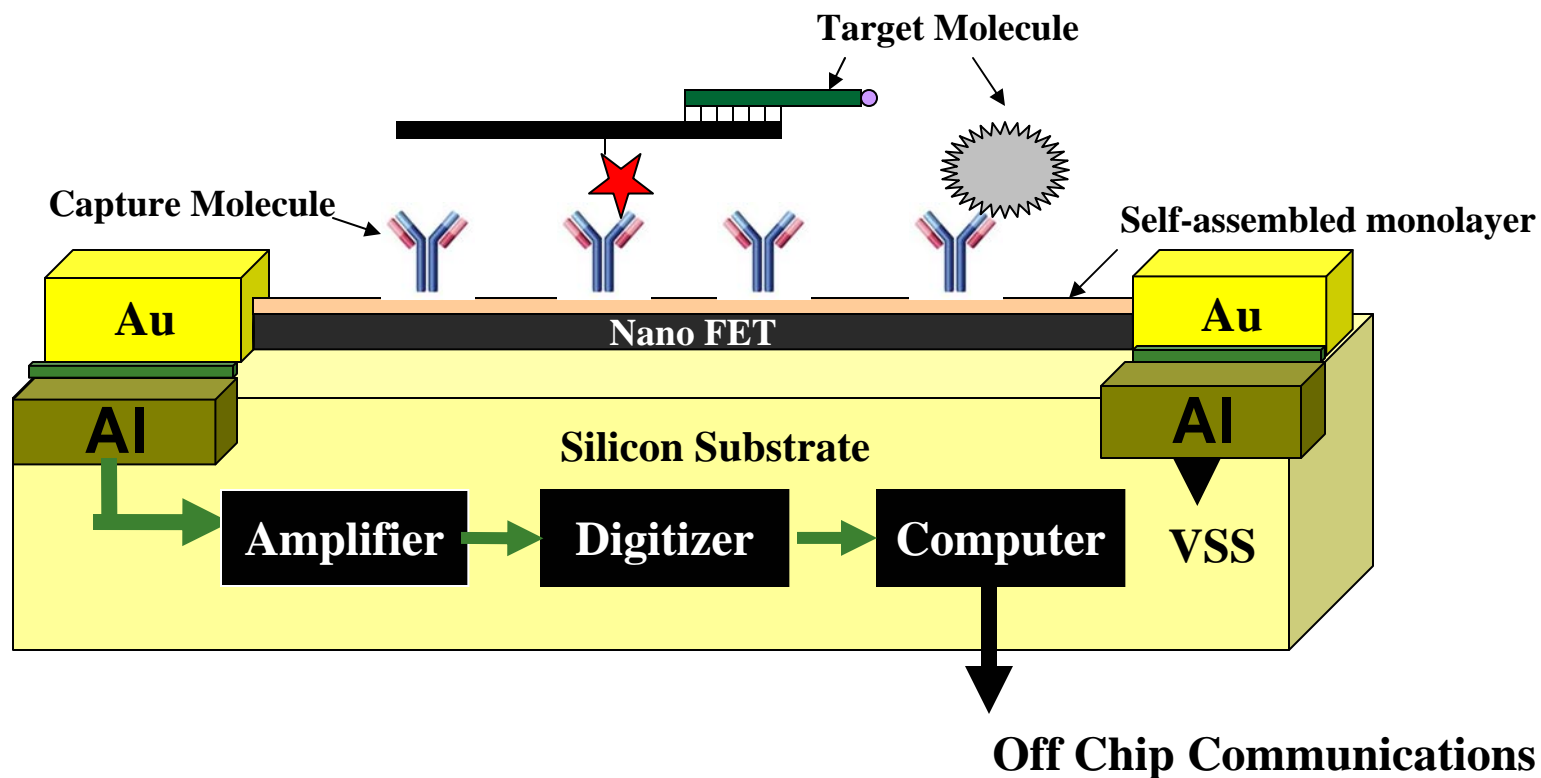


Universal Nano-FET Biosensor

Detection of Staphylococcus aureus Toxin B

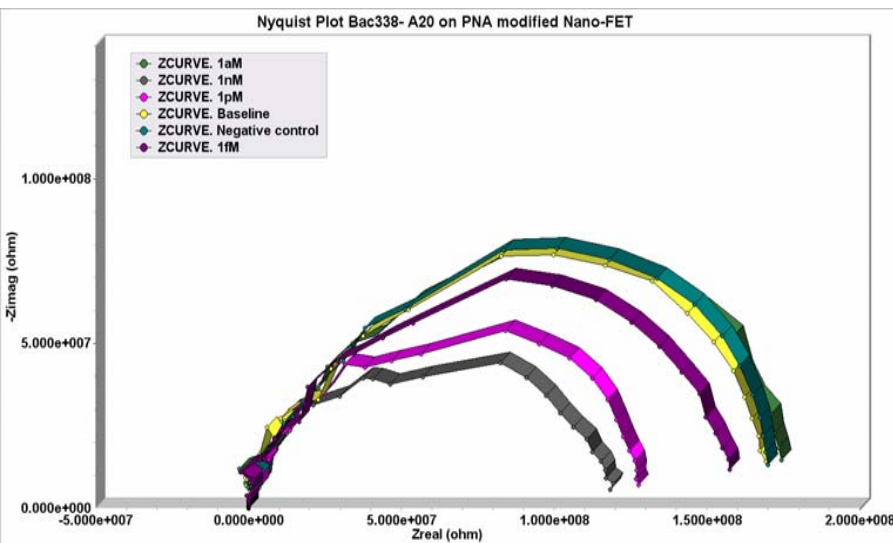


Towards Integrated Electronic Molecular Sensor

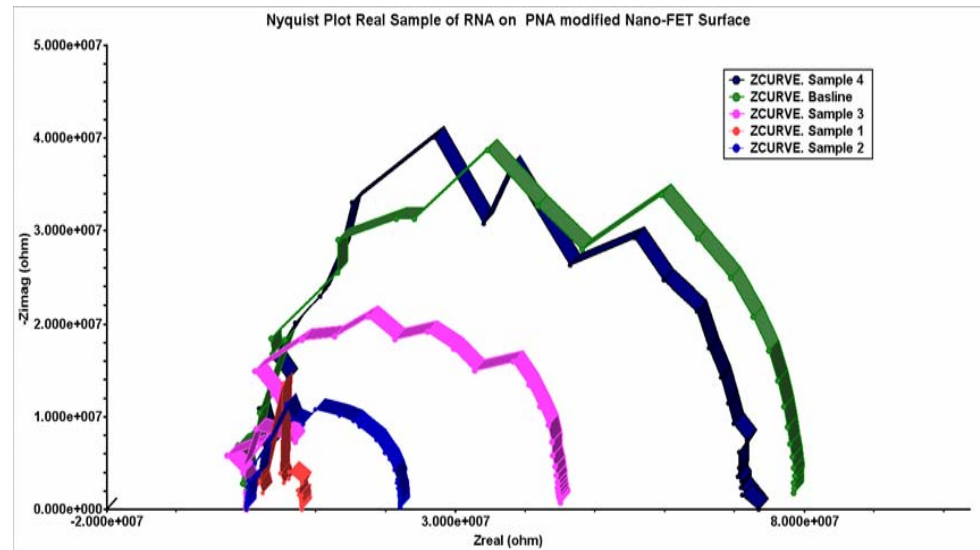


Detection of 16S rRNA of Staphylococcus aureus

Oligonucleotide Bac338-A20 detection



Staph. 16S rRNA detection



Conclusion

- 1. Developed nano electronic system with early results showing high sensitivity and selectivity**
- 2. Integrating nano electronics with deep submicron electronics**
- 3. Goal is to provide complete electronic system soon**