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Si-based DNA nanosensing

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ISN @ UNL




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Outline

- Introduction
- System
- Results
- Conclusions



Nano ... "things" ?

Nanostructures

Nanomaterials

Nanobiotechnology



Nanosensors

Nanochemistry

Nanosensors




The "age" of nanomaterials?

Material	The Lycurgus Cup (%)	Modern Glass (%)
Silicon dioxide	~75	~75
Sodium oxide	~15	~15
Calcium oxide	~10	~10

Lycurgus cup

<http://www.thebritishmuseum.ac.uk/>




Tremendous impact on nearly all industries

↑

Nanotechnology

↓

Healthcare/Nanodiagnosis



Objective

Development of an innovative & inexpensive optoelectronic platform for biomolecular recognition;

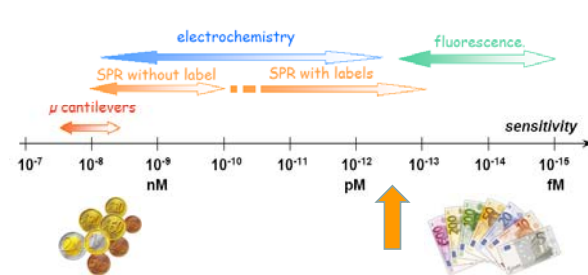



point-of-care hand-held devices

- Mutations/Polymorphisms responsible for human diseases
- Gene expression (functional studies)
- Presence of pathogenic micro-organisms
- Development of a miniaturized integrated system for clinical applications



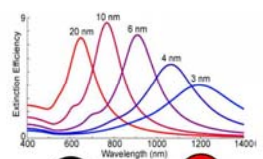


Available techniques





The method:

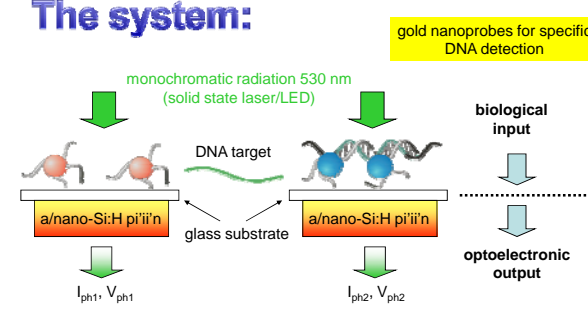
Size Matters

Colorimetric detection of nucleic acids based on oligonucleotide-derivatized gold nanoparticles.



The system:



gold nanoprobe for specific DNA detection

monochromatic radiation 530 nm (solid state laser/LED)

DNA target

glass substrate





biological input

optoelectronic output

Label free. No need of surface functionalization.


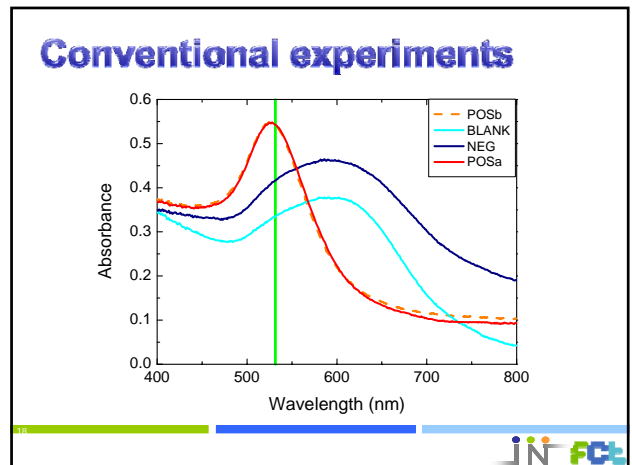
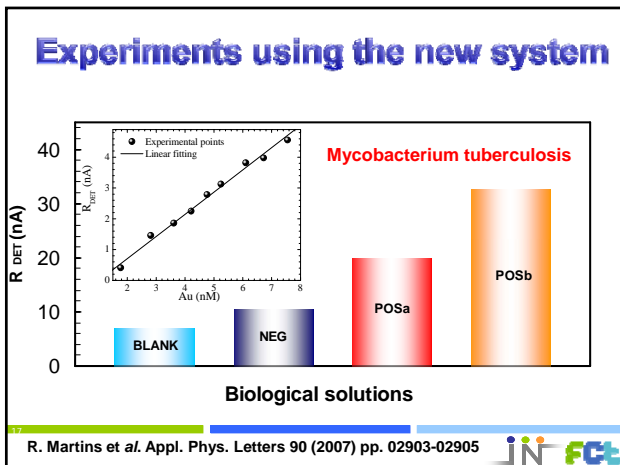
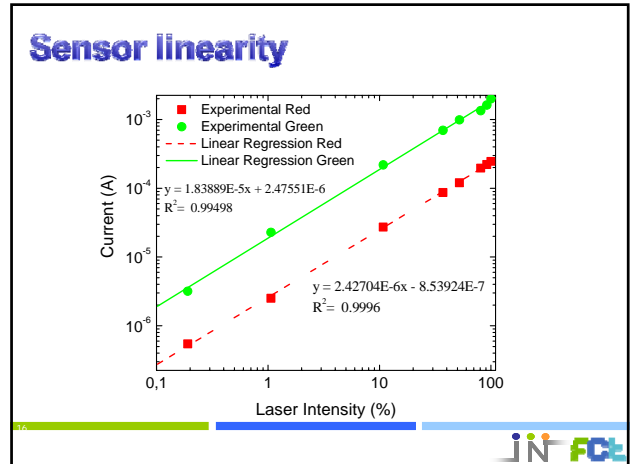
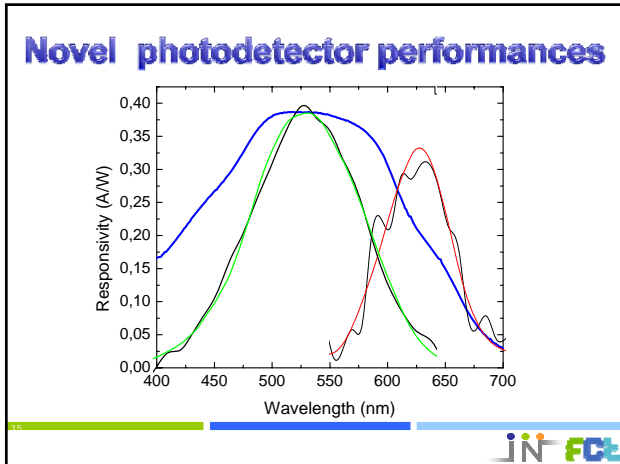
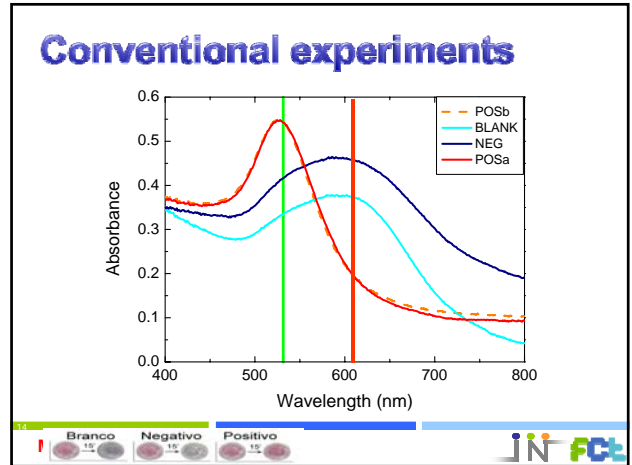
amorphous/nano crystalline biosensor

Patent nº 103 561 (2006)

Experimental details

- Biotechnology: DNA/RNA expression
- Chemistry: gold nanoparticles functionalization
- Materials Science: sensor development (a-Si:H; PECVD)

Main conclusions

We have presented an innovative optoelectronic platform for the colorimetric detection of nucleic acids based on oligonucleotide-derivatized gold nanoparticles. The device integrates an amorphous/nanocrystalline biosensor and a light emission source with a gold nanoprobe for specific DNA detection.

The described system presents several advantages: i) no need to functionalize the glass surface with probe DNA; ii) the sample is directly applied on the back side of the biosensor ensuring maximum photon capture and the possibility of re-use; iii) requires small amount of biological sample.

The system combines two technologies - gold nanoparticle based DNA detection and optical/color sensors based on thin film technology - leading to significant cost and time savings in DNA/RNA assays (picomole detection), allowing for molecular diagnostics at point-of-care without compromising specificity and sensitivity.

