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Label-free electrical DNA and protein sensors for portable instrumentation

Pedro ESTRELA

Department of Electronic & Electrical Engineering
Center for Advanced Sensor Technology

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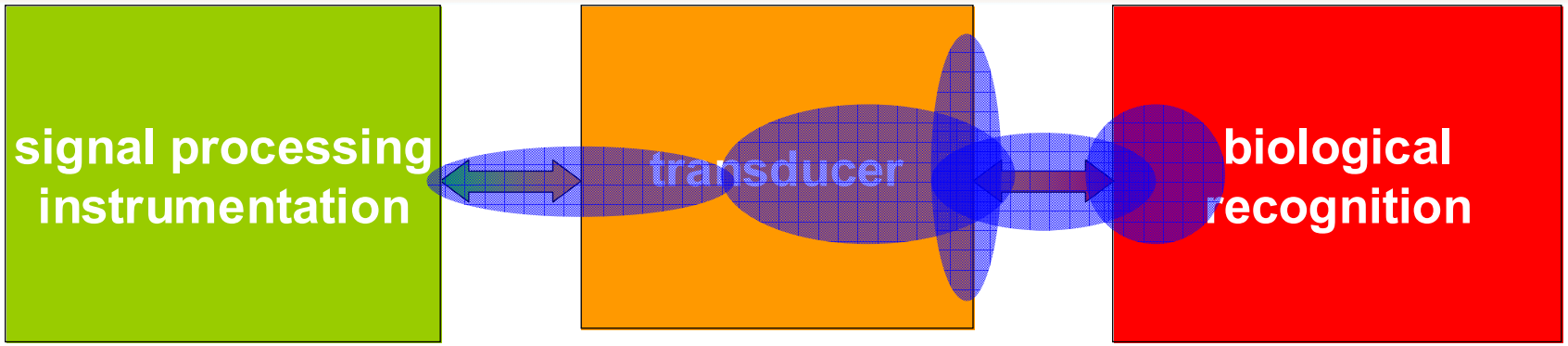
Biosensors – areas of research



- **Interfacing transducers with biomolecules**
- **Determine type of sensor useful for specific biomolecular interactions**
  Surface immobilisation of biomolecules
- **Adapting electric and electronic devices for biosensor/aqueous use**
- **Optimization of transducer characteristics for biosensor application**
- **Specification of transducer characteristics for signal processing**

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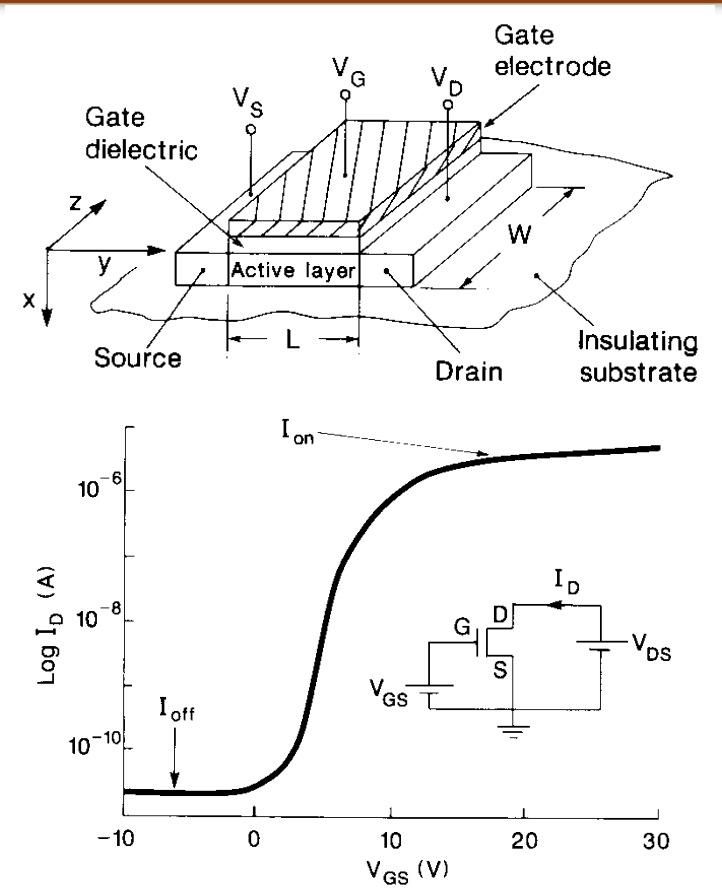
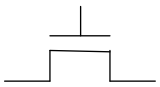
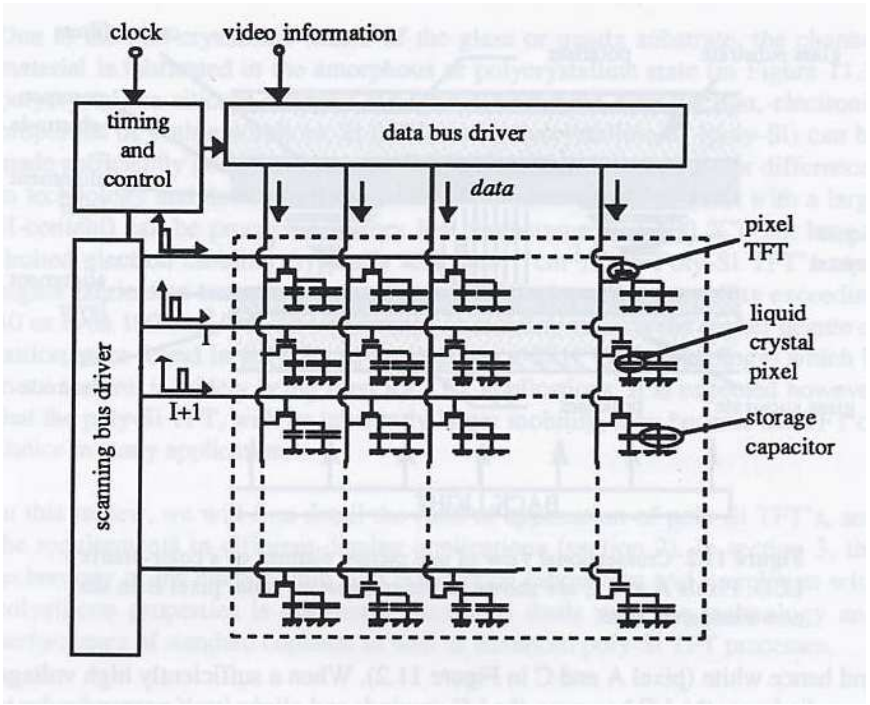
Field-Effect Transistors







Circuit Architecture of a TFT-addressed LCD

Technologies: CMOS, α-Si:H TFT, Poly-Si TFT, organic TFT, amorphous oxide semiconductor TFT, nano-FET (SiNW, CNT, ...)

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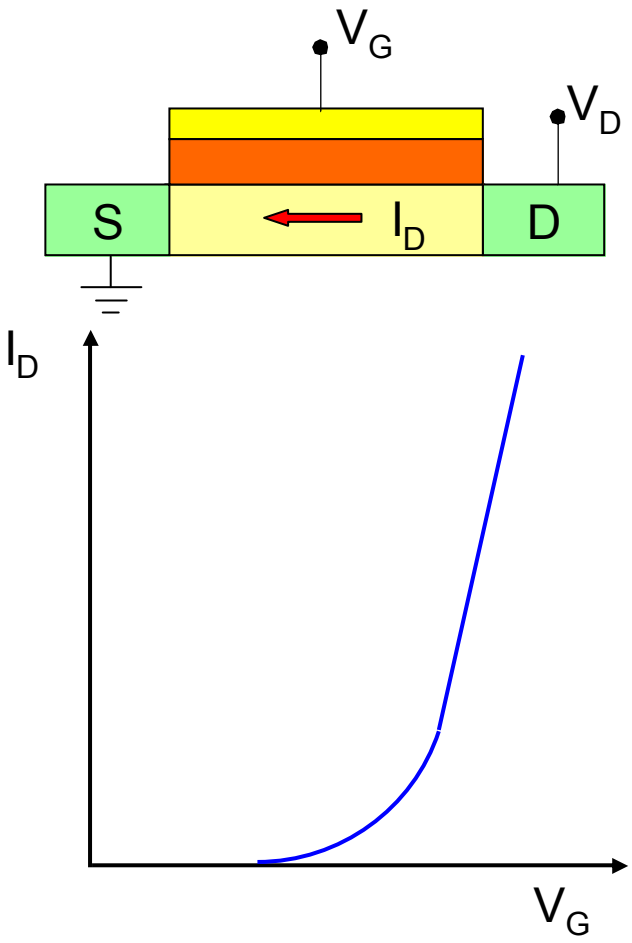
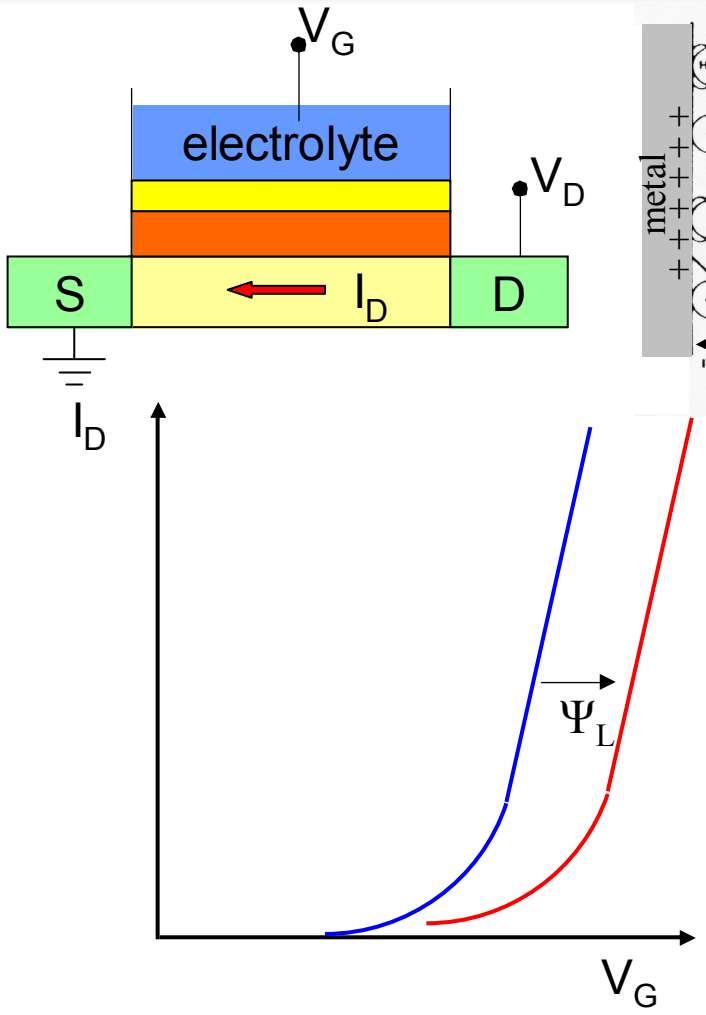
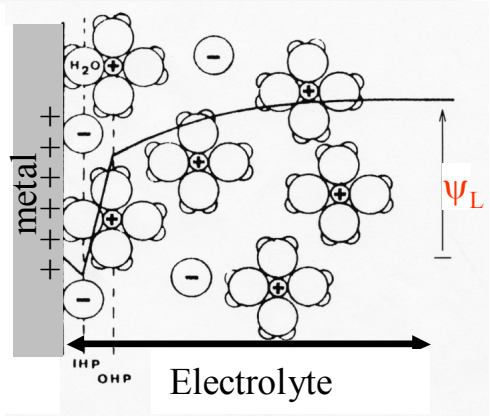
BioFETs







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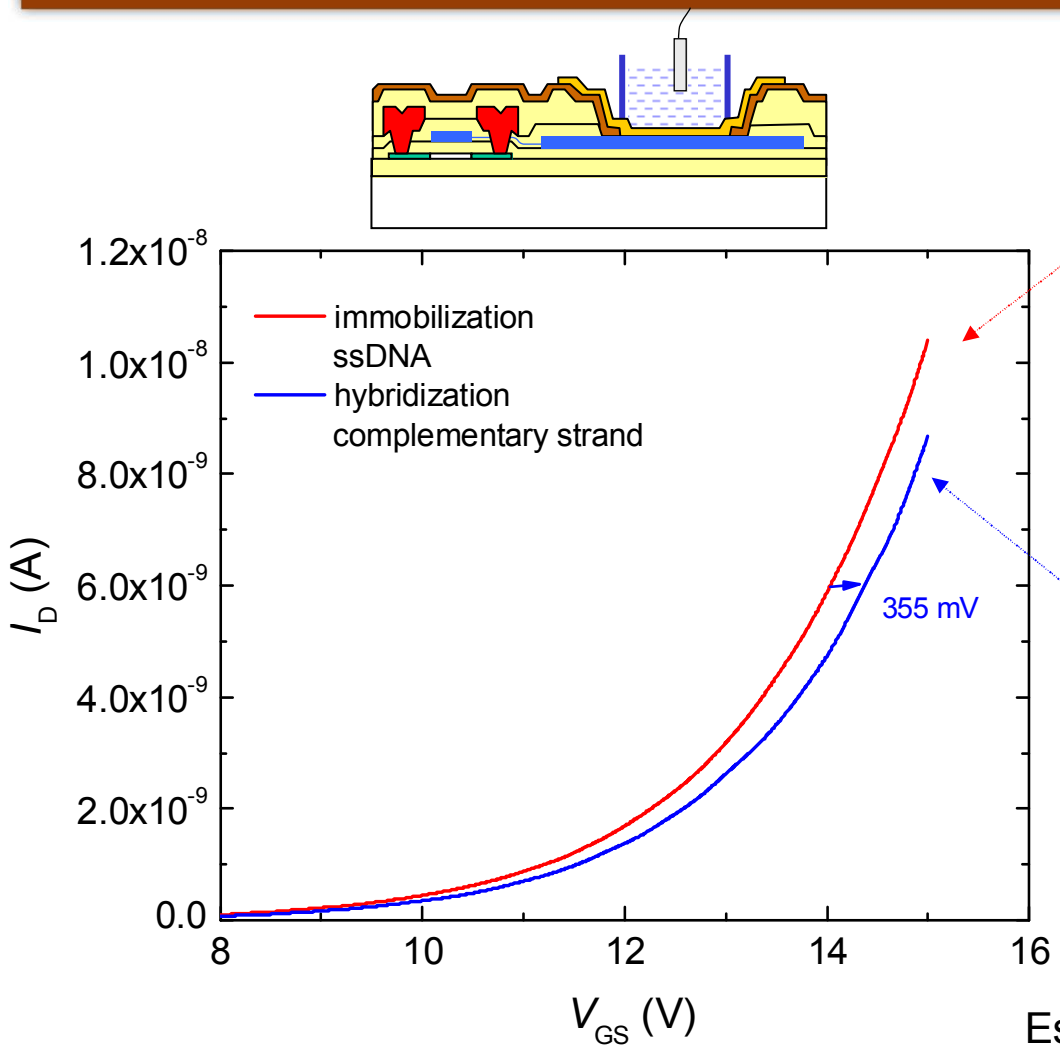
BioFET: DNA



Estrela *et al.*, Electrochim. Acta 50, 2005, 4995

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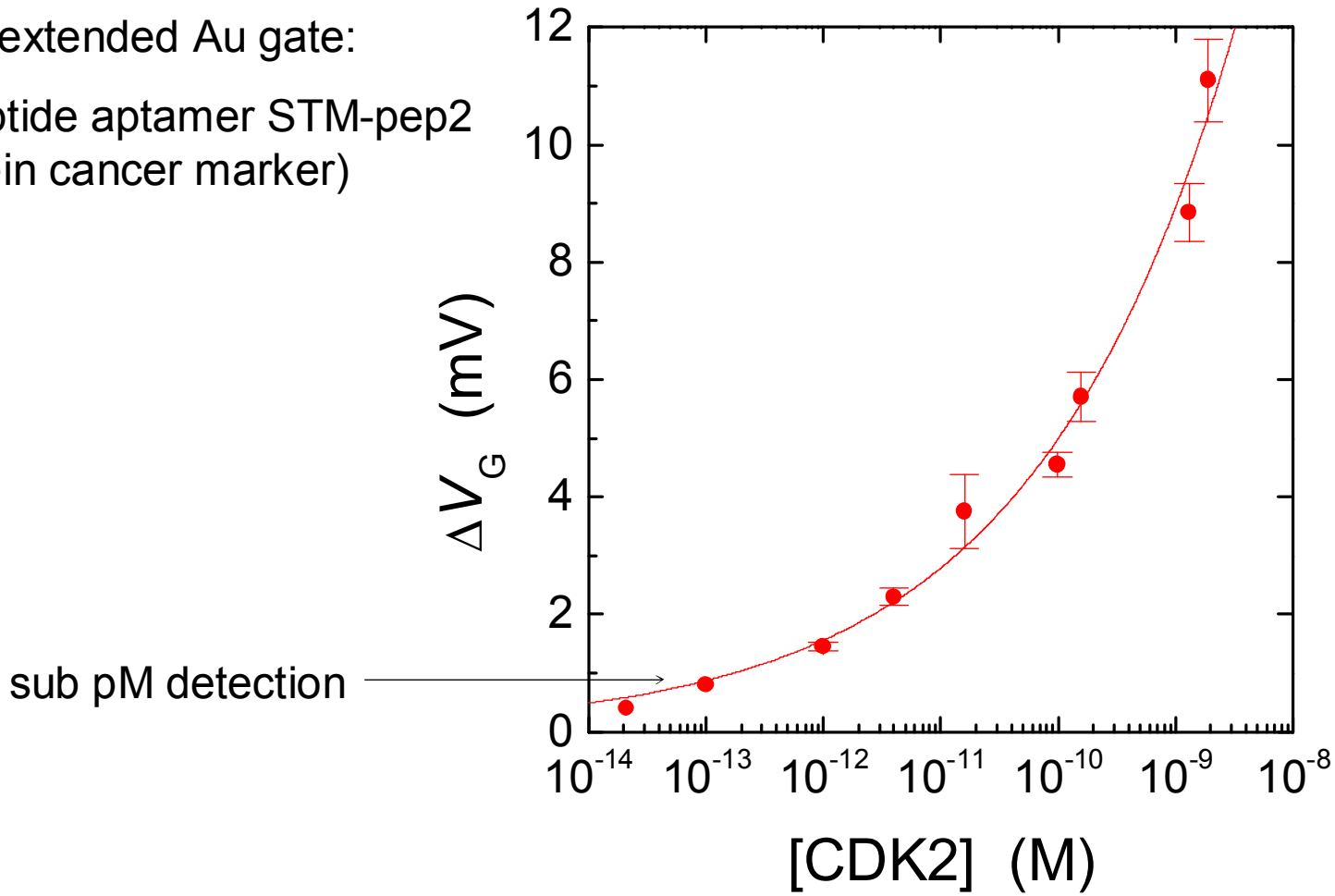
BioFET: proteins

- CMOS FET with extended Au gate:

  interaction of peptide aptamer STM-pep2 with CDK2 (protein cancer marker)



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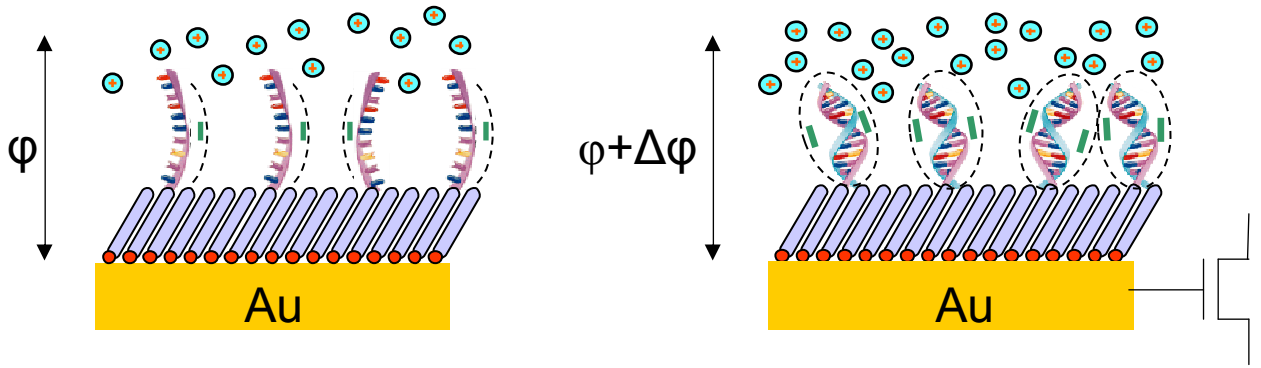
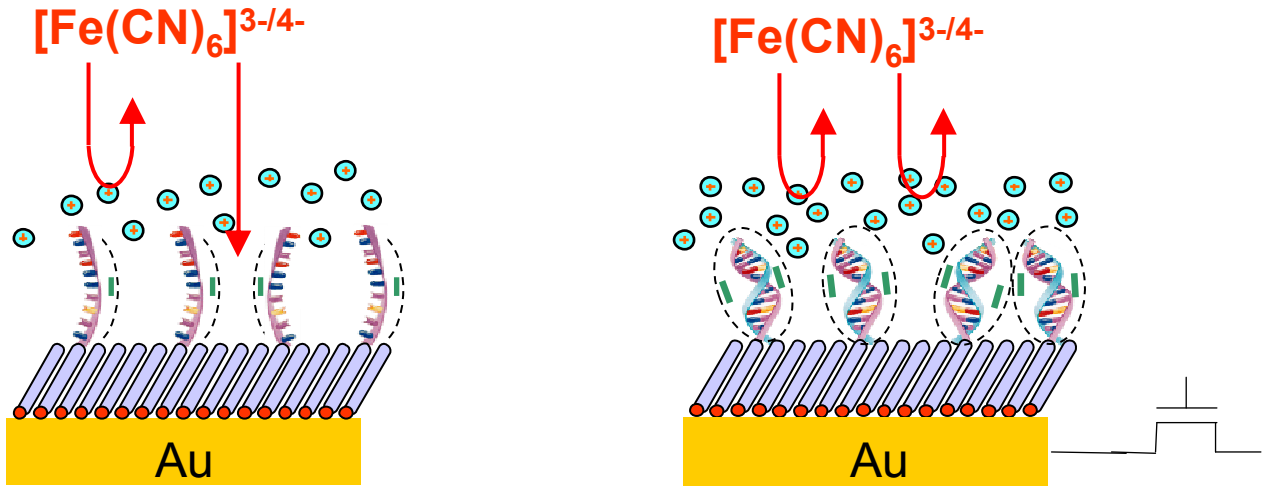
Electrochemical Impedance Spectroscopy

Field effect detection



EIS detection



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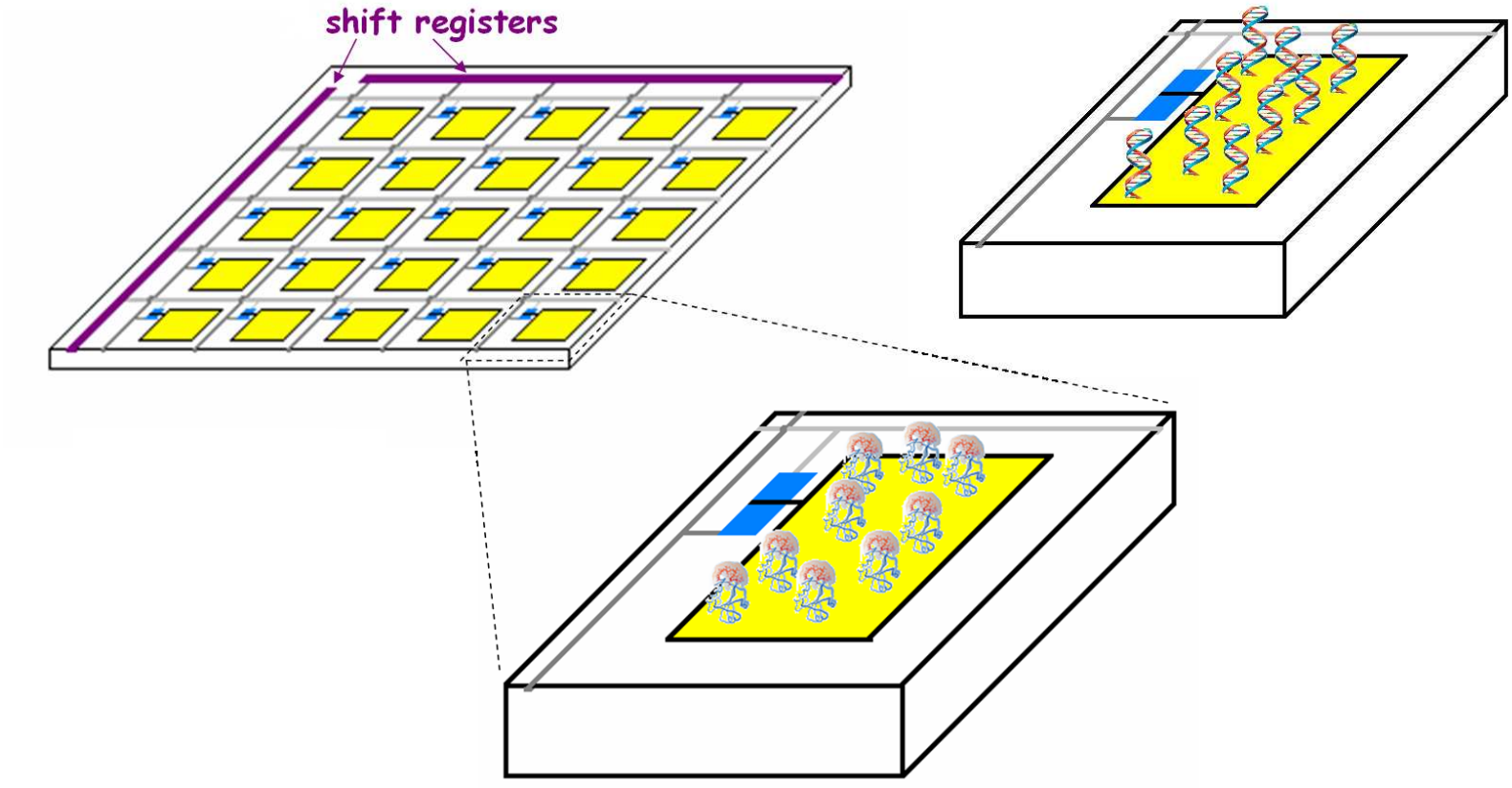
DNA / Protein Arrays



Potentiometric: signal mainly depends on charge density effects

- signal-to-noise ratio independent of sensing pad area

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Arrays

- Requirements for next generation (micro)arrays:
  - label-free assay
  - suitable for DNA, proteins, cells, etc
  - compact, high-performance
  - portability: integrated detection and read-out
  - low cost & disposable

- Electrical detection
  - integrated scanning
  - integrated drivers for low number edge connectors
    - ↳ multichannel array detachable from instrument

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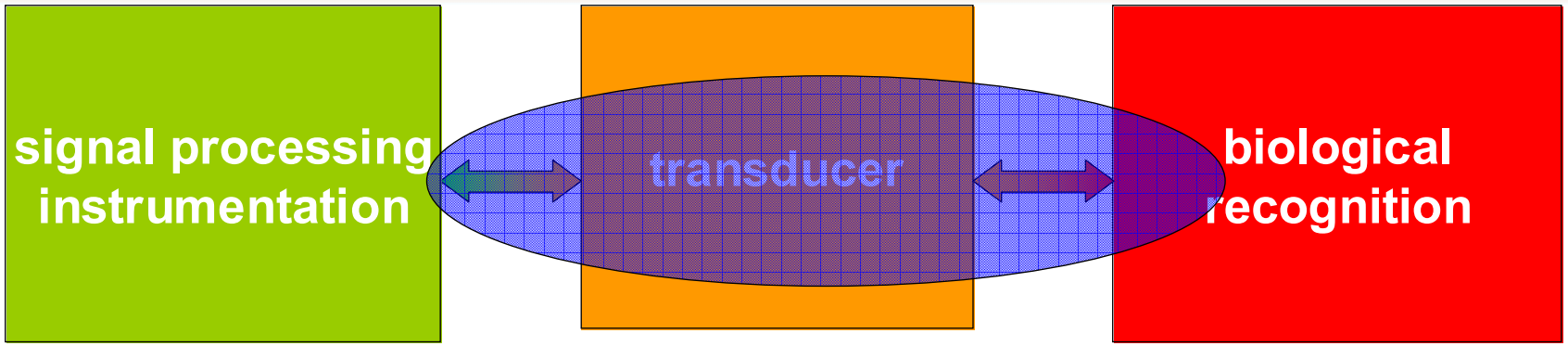
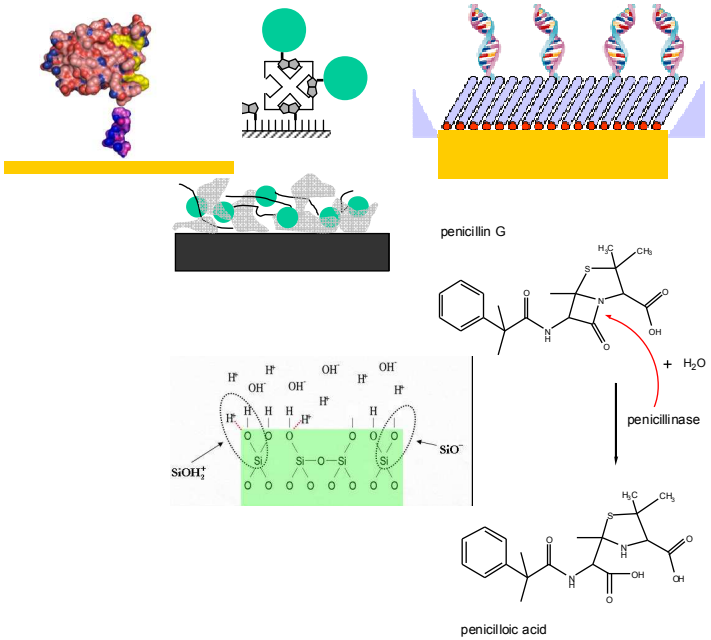


pH
enzymatic reactions
DNA hybridisation
protein interactions



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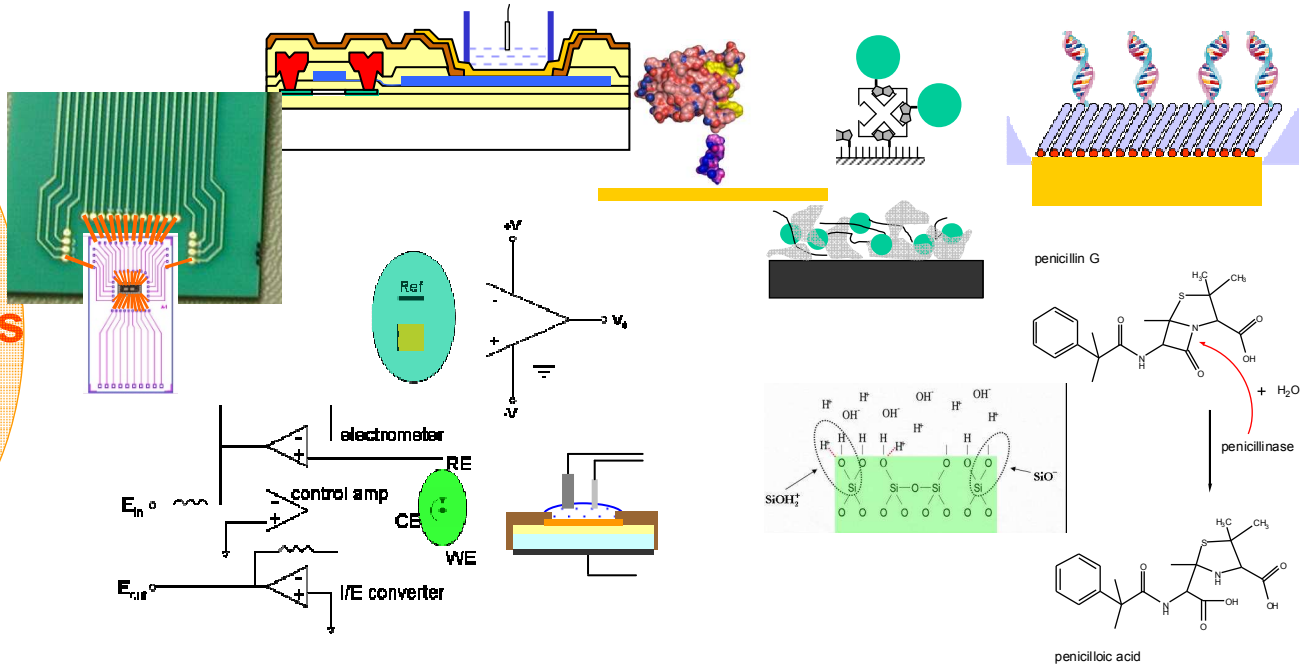
Biosensors – areas of research

signal processing instrumentation

transducer

biological recognition

MOS
electrolyte-OS
FET (metal gate)
FET (dielectric gate)
electrochemical sensors
(impedance spectroscopy)
(potentiometric)
(amperometric)



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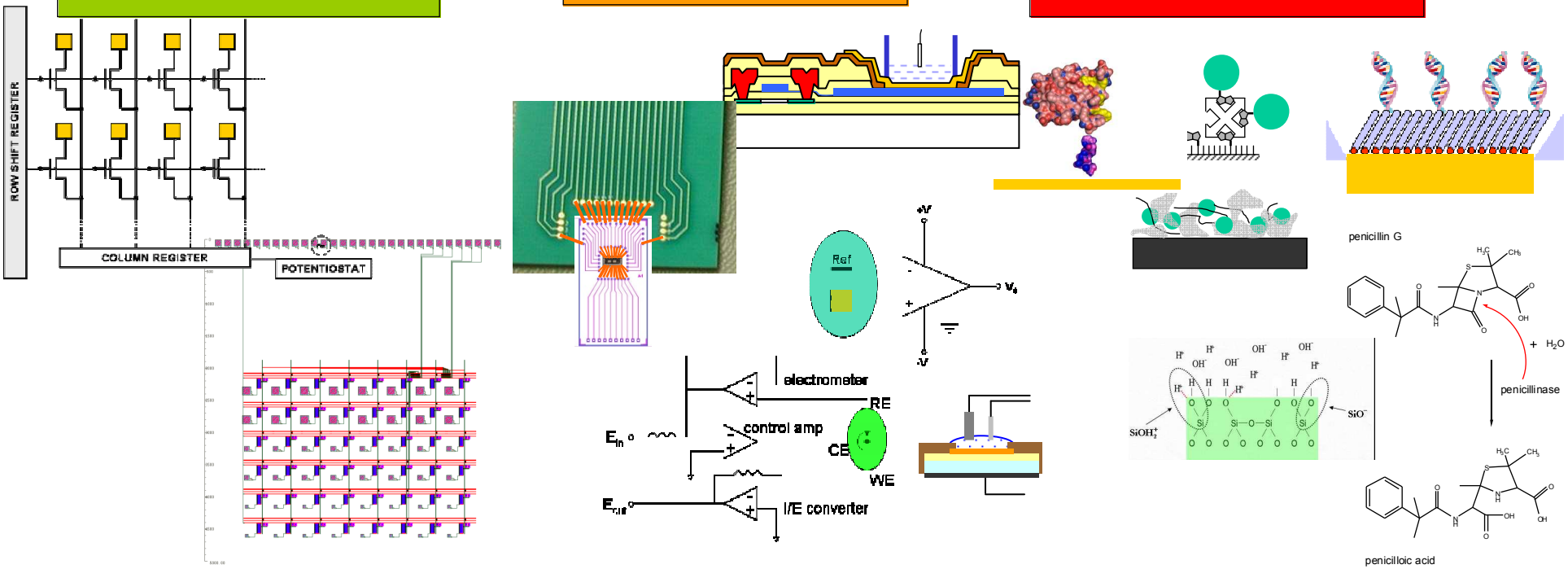

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References:

Estrela and Migliorato, J. Mater. Chem. 17 (2007) 219

Estrela *et al.*, Electrochim. Acta 53 (2008) 6489

Keighley *et al.*, Biosens. Bioelectron. 24 (2008) 912

Interested in:

New label-free techniques (electrical and otherwise)

Nanobiosensors

Biological systems for label-free detection

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P.Estrela@bath.ac.uk; 2E 2.21, ext. 6324