



Design & Test of an Oscillation Based System Architecture for DNA Sensor Arrays

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30/05

«Design for Micro & Nano Manufacture (NoE PATENT-DfMM)»
Network of Excellence funded by the European Commission (EC FP6: IST, Unit C2, Contract 507255)



Acknowledgements

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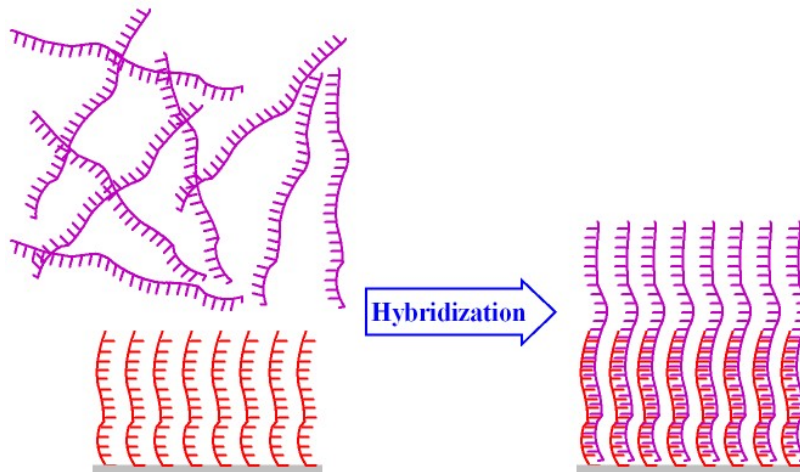
- This work has been supported by the FP6 Network of Excellence in Design for Micro & Nano Manufacture "PATENT-DfMM" contract no. 507255
- We would also like to thank Daniela De-Venuto of Polytechnic de Bari for proposing that this study be carried out under the NoE framework

- Introduction to DNA Hybridization
- Sensing Element Model
- Bio-sensing Array Implementation
- System Architecture
- Future Work

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DNA Hybridization

- Probe DNA Immobilized on the Electrode Surface
- Target DNA Specific Binding with Probe DNA

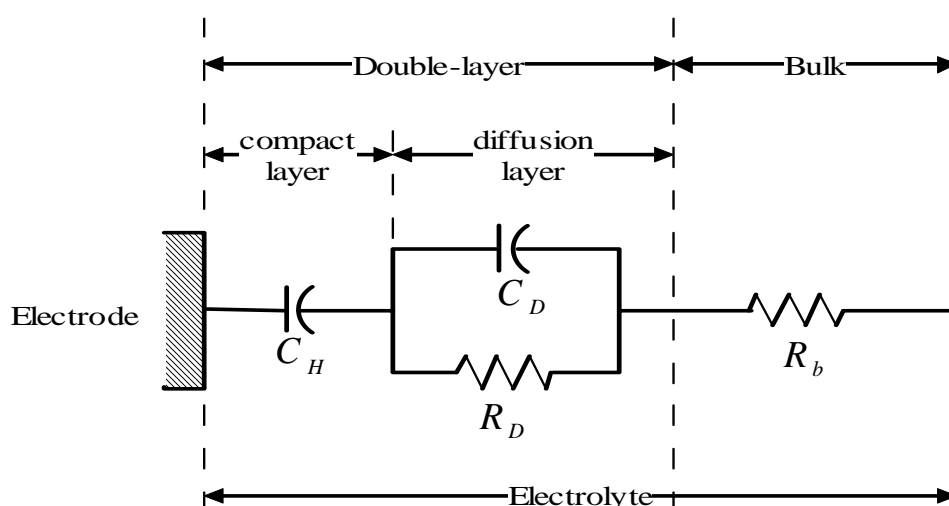


- Detection Techniques for DNA Hybridization

Detection Techniques for DNA Hybridization	Underlying Mechanisms
Detection by Indicators	The indicator has better affinity with the hybridized dsDNA than with the ssDNA. Its binding to the dsDNA on the surface of electrode is a redox process.
Detection by Enzyme-label	The target ssDNA is labelled with an enzyme, which gives rise to a redox process after the hybridization process.
Indicator-free Detection	Directly detecting the change of electrical properties on electrode surface induced by hybridization process.

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- Electrical Model for Electrode/Electrolyte Interface in case of Non-Faradaic process



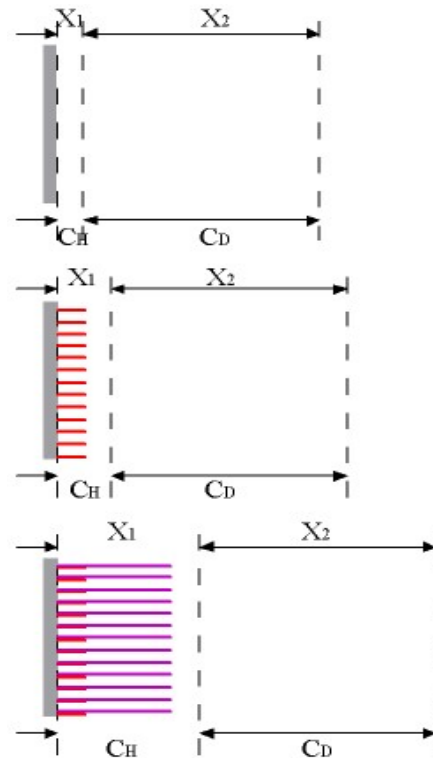
□ DNA Hybridization Process

$$\frac{1}{C_d} = \frac{1}{C_H} + \frac{1}{C_D}$$

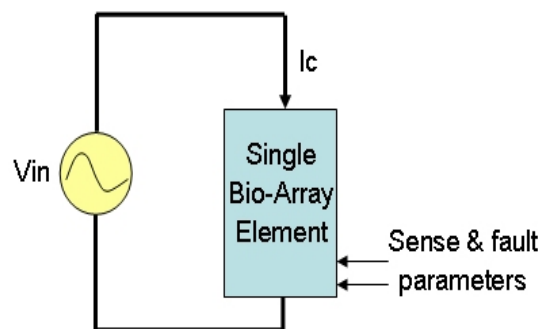
$$C_H = \frac{\epsilon_{rH}\epsilon_0}{x_1}$$

$$C_D = \frac{\epsilon_{rD}\epsilon_0}{x_2} \cdot \cosh\left(2 \frac{e\phi_0}{k_B T}\right) \approx \frac{\epsilon_{rD}\epsilon_0}{x_2}$$

$$x_2 = \sqrt{\frac{\epsilon_{rD}\epsilon_0 k_B T}{2n_0 e^2}}$$

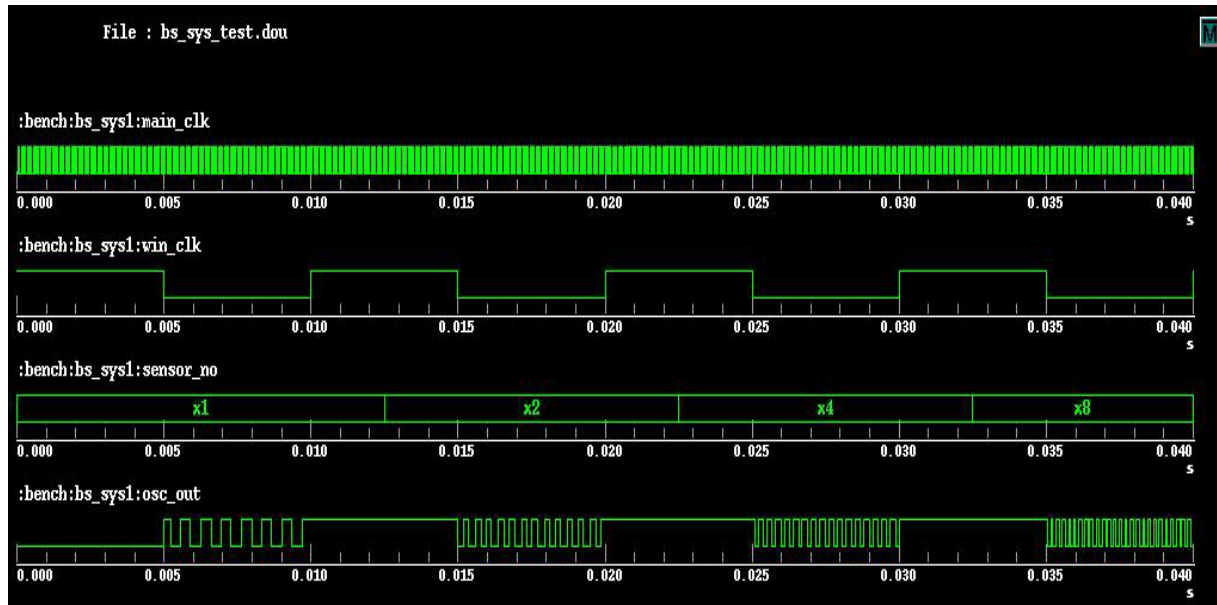


- VHDL-AMS Simulation of the variation of I_c during hybridization process based on the proposed model



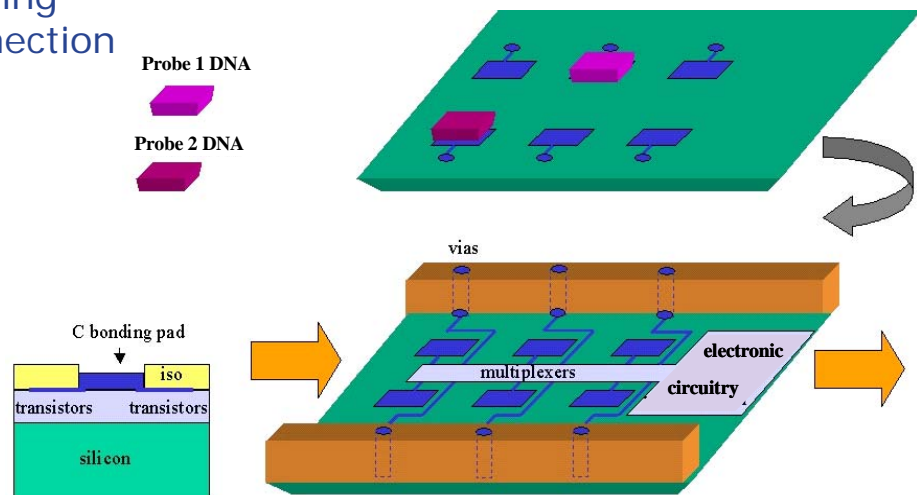
	V_{in} (V)	ϵ_{rH}	x_2 (nm)	I_c (μA)
Bare electrode	0.5	80	1	20
Functionalization	0.5	1.9	2	4
Hybridization	0.5	2.5	5.5	2.3

- VHDL-AMS simulation for oscillation based structure on behaviour level



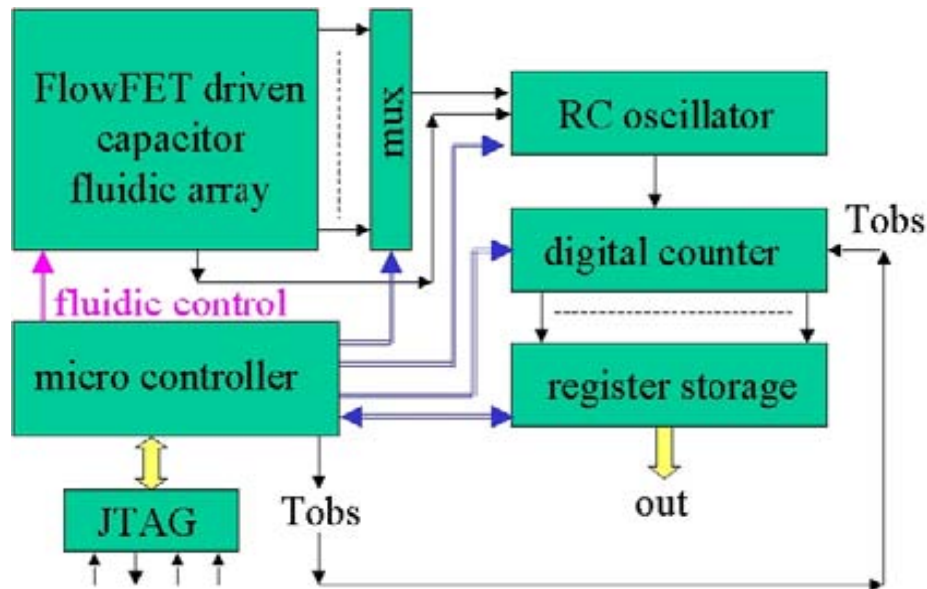
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- Boundary Conditions & A Possible Implementation
 - Uniform Flow Along All Electrodes
 - Probe DNA Deposited by End-users
 - Gluing Bonding
 - Layers Connection



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□ An Oscillation Based System Architecture



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- Physical implementation of the array
- To develop a fault-free and faulty model of the bio-sensor arrays
- To construct a simulation environment in VHDL-AMS