DNA-based memristors as a component for green self-organizing information processing systems

Motivation

Commercially available components for information processing systems are based on inorganic heterogeneous materials. These materials are obtained with a high energy and chemical input and, due to their heterogeneous structure, can only be recovered to a limited extent. Organic materials, on the other hand, can be produced sustainably and energy-efficiently and allow for a more efficient circular economy compared to inorganic systems.

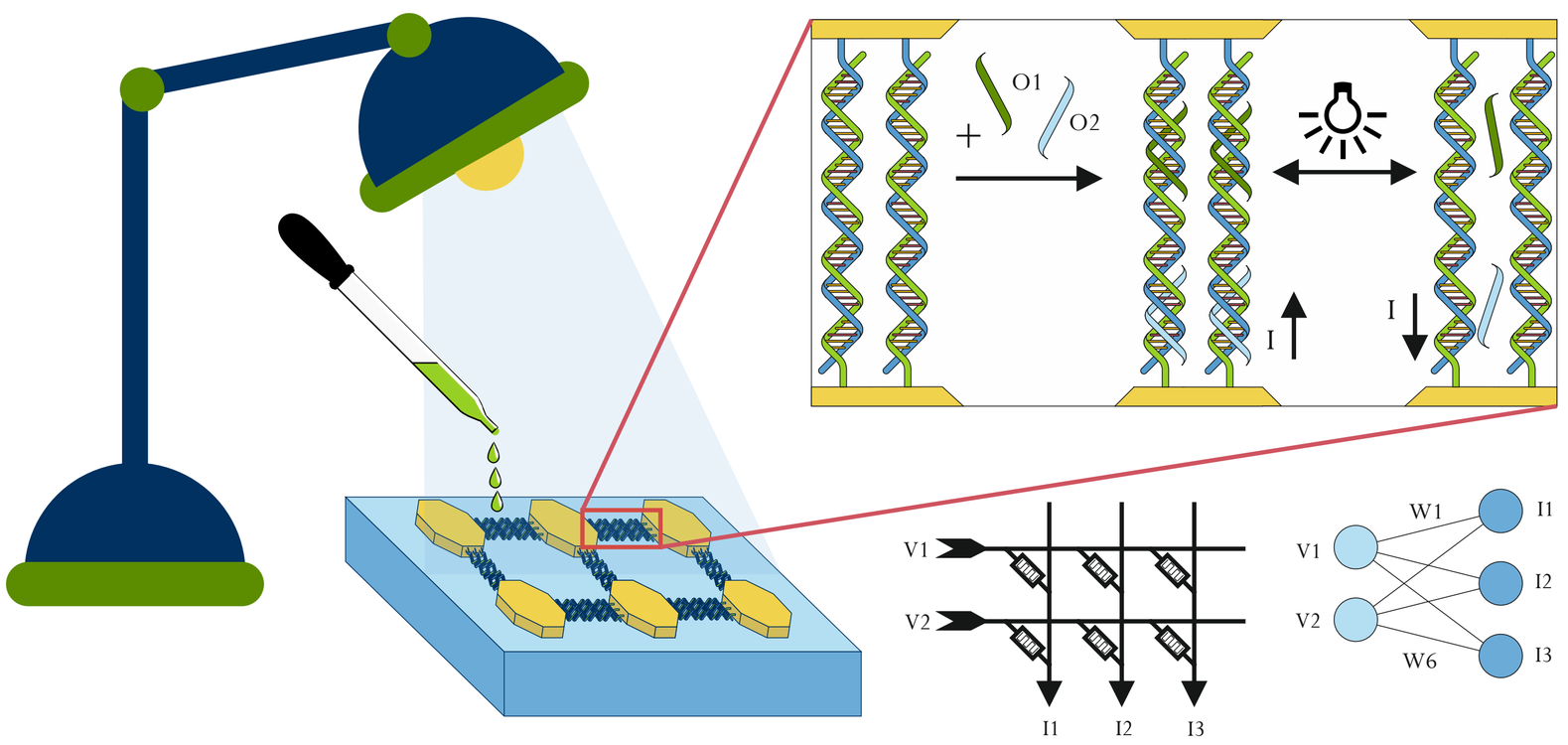
DNA is an organic molecule that has great potential for use in neuromorphic systems due to its properties. DNA-based information processing systems are not only energy-efficient, sustainable and recyclable, but can also be repaired adequately to the mechanisms in organisms.

Project Goal

The aim of the project is to develop intelligent components for bio-inspired information processing. The following sub-objectives are to be achieved:

- Production of DNA-based memristors (with defined sequence, structure and orientation)
- Building an array of memristors
- Change in conductivity due to the controlled reversible attachment of short oligonucleotides
- Using Devices for Intelligent Pattern Recognition

The use of defined designed sequences should contribute to the understanding of the memristive properties of DNA.



DNA is
- biocompatible
- biodegradable
- renewable
- sustainable
- conductive
- repairable
- self-organizing

DNA is suitable as
- memristor
- nanowire
- non-volatile memory
- logical AND operator
- …

Work Packages

Work package A: The design and immobilization of oligonucleotides is developed in the Department of Biotechnical Micro- and Nanosystems for the Life Sciences (Dr. Reich).
Work package B: The nanogap electrode array is manufactured in the Department of Nanotechnology (Dr. Pezoldt). The project aims to develop electrodes with a distance of 30-170 nm and passivation adapted to the application.
Work package C: The integration of oligonucleotides into the electrode structures
Work package D: The assembly and connection technology will be developed in the Department of Electronics Technology (Dr. Bartsch).
Work package E: Characterization of switchable electrical properties

Milestone 1: Functionalization of large contact surfaces with oligonucleotides
Milestone 2: Functional DNA Memristor
Milestone 3: Switchable system through the reversible self-organized attachment of short oligonucleotides

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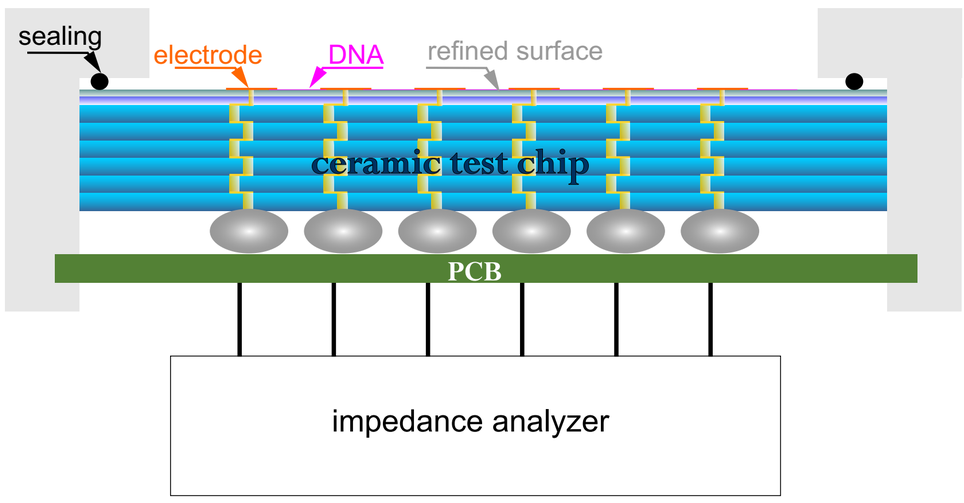

Schedule

Work Package	1-6	7-12		13-18	19-24		25-30	31-36	
A – DNA	50%	50%	Milestone 1			Milestone 2			Milestone 3
B – El	50%	50%		30%	30%				
C – DNA+El				50%	50%				
D – ACT				20%	20%		50%		
E – Char							50%	100%	

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