ETH zürich

Master Thesis

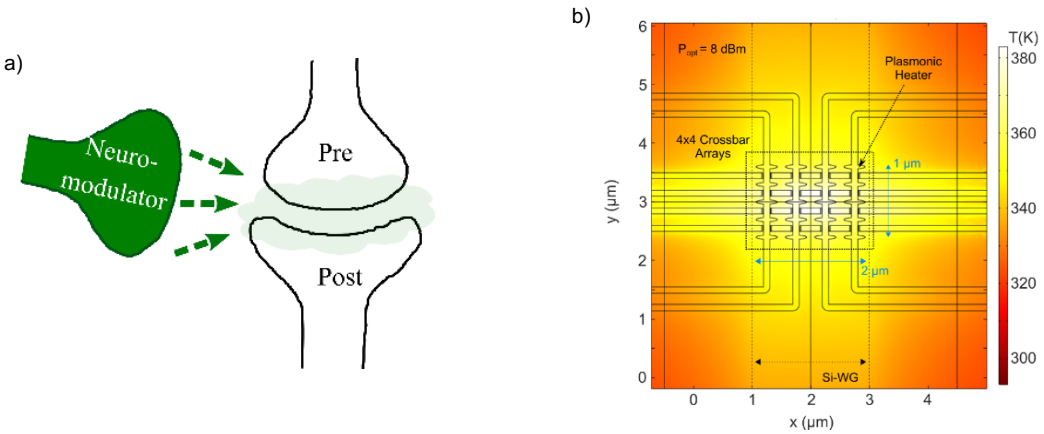
Design and Characterization of an Artificial, Electro-Optical Synaptic Network

Short Description

Our group investigates artificial electro-optical synapses to build brain-inspired computing architectures. The weight of these synapses is not only controlled by pre- and post-synaptic signals but additionally modulated by an optical input. This allows to emulate the role of neuromodulators in the human brain which play a pivotal role in learning tasks. Based on the previously designed single electro-optical synapse, the goal of this project is to design an electro-optical synaptic array that maximizes the interaction with light followed by the fabrication and characterization of these structures.

The Big Picture

The mammalian brain remains the pinnacle of computational efficiency using only 20 watts of power as opposed to 25'000 watts per petaflop for the currently most efficient supercomputer. For this reason, bioinspired computation paradigms such as spiking neural networks (SNNs) have received enormous interest. However, as modern computers are architecturally different to the brain, such computing systems are greatly limited in their capabilities and efficiency. The goal is to use electro-optical synapses based on the emerging technology called memristors to implement such neural networks in hardware.



a) Illustration of neuromodulation in the brain. b) Heat simulation of an artificial neural network consisting of electro-optical synapses

Type of Work

The exact scope of the thesis can be tailored to your interests and skills:

- Simulate the interaction of our current electro-optical synapses with light using Lumerical
- Design of a synaptic array structure that maximizes the effect of light
- Fabricate the designed structures in the clean room and characterize them in our lab

Prerequisites

We are looking for a candidate with a general interest in optics and fabrication in a clean room. Basic programming skills and knowledge in Python and/or COMSOL/Lumerical are beneficial.

Contact Details

Interested candidates please contact: Till Zellweger → till.zellweger@iis.ee.ethz.ch
ETH Supervisor: PD Dr. Alexandros Emboras → aemboras@ethz.ch

Integrated Systems Laboratory (IIS)