Integrating Molecular Photoswitch Memory with Nanoscale Optoelectronics

David Alcer*[1], Nelia Zaiats*[1], Thomas K. Jensen*[1], Abbey M. Philip[2], Evripidis Gkanias[3], Abhijit Das[1], Stanley Heinze[4], Magnus Borgström[1], Barbara Webb[3], Bo W. Laursen[2], Anders Mikkelsen[1]

[1] *Department of Physics and NanoLund, Lund University, Sweden*
[2] *Nano-Science Center and Department of Chemistry, University of Copenhagen, Universitetsparken 5, 2100 Copenhagen, Denmark*
[3] *School of Informatics, University of Edinburgh, 10 Crichton St, EH8 9AB, Edinburgh, UK*
[4] *Department of Biology, Lund University, Sweden*
** These authors contributed equally to this work*

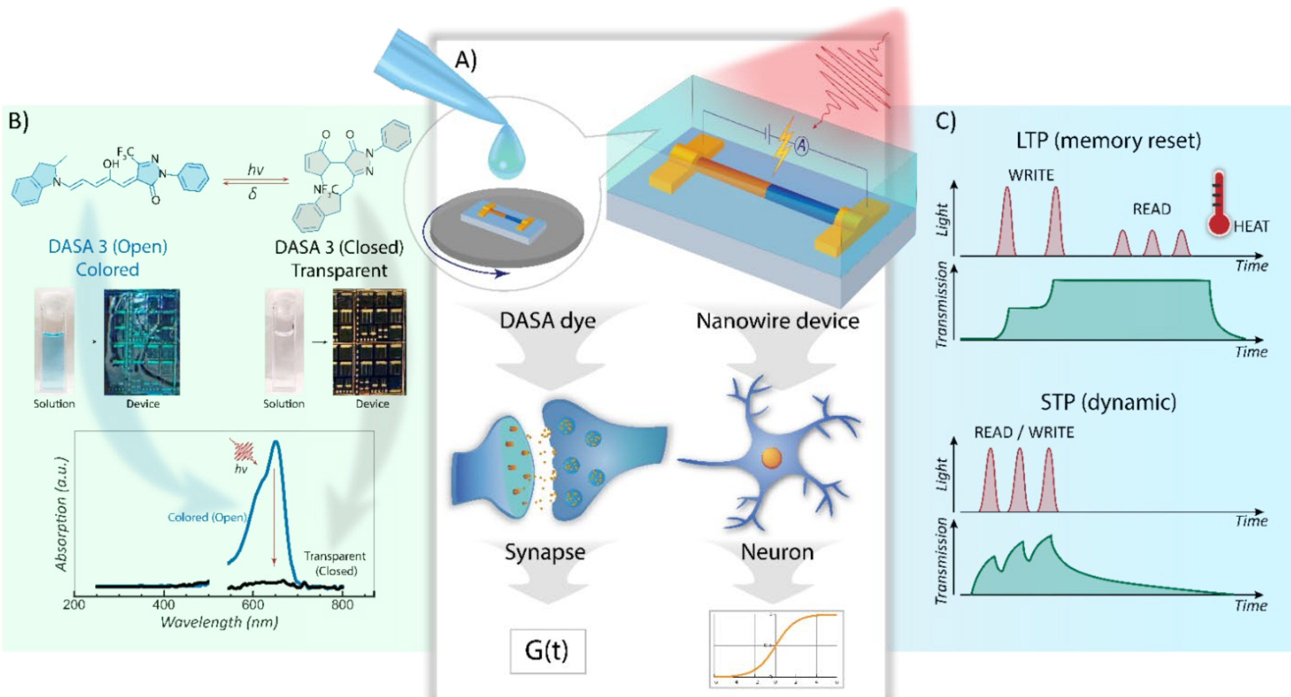

Figure 1: DASA synaptic effect and fundamental function with III-V optoelectronic components. A) DASA photoswitch (DPS) is deposited on nano-optoelectronic components such as a single III-V nanowire in the sketch. Light then act as signal carrier, the dye acts to give (synaptic) weight to the transmission which can be modulated via light. A nanowire optoelectronic device receives the light signal and interprets it via a sigmoid function thus acting as an artificial neuron [24]. **B)** At the top we show the reversible two structural configurations of the DPS. DPS response in toluene solution and on a nanowire array device are shown in the middle, both give a clear response. The absorption spectra in toluene solution of the colored (open) and transparent (closed) DPS is shown in the bottom of B. **C)** Fundamental functions that the photoswitch can perform. At the top we sketch long term plasticity (LTP) with a long memory time constant in which strong (write) light pulses will make the photoswitch more transparent, thus the connection becomes stronger for weaker (read) light pulses that acts as signals between neurons. The memory can be reset with a mild thermal pulse as this significantly lower the memory time constant. At the bottom we sketch short term plasticity (STP) in which the memory time-constant of the photoswitch on a similar timescale as the response of the dye to the light pulses, in essence the time interval between pulses. This results in a dynamic interplay between the pulses/spikes of the neural system and the memory. When a neural network is constructed using such a dynamic weight situation highly complex behaviour can emerge.