

LIFT-immobilized thylakoids for assessment of astaxanthin preservative effects on Si-NWFETs.

Device definition

A biosensor based on field effect transistor detection used as screening tool to determine the capability of various compounds to preserve/restore the photosynthetic activity of photosystem II (PSII).

Constructive principle:

The biosensor consists in functionalization of Si-NWFETs chips with spinach thylakoids using Laser Induced Forward Transfer (LIFT) process for thylakoids immobilisation.

Measuring principle:

The PSII-Si-NWFET probes, acting as the back-gate, drain and source electrodes, are connected to a Keithley 4200 SCS/C system in direct current (DC) and the signal is recorded. Optimum gate source voltage (VGS) is applied to the silicon substrate ($VGS = 1V$) to monitor the changes of drain currents (I_d). The light activation of the photosynthetic PSII thylakoids is performed by irradiating the PSII-Si-NWFET at a fixed wavelength of 645 nm and a family curves I_{ds} - V_{ds} is registered for unstressed PSII. Further I_{ds} - V_{ds} family curves is registered for different concentrations of PSII inhibitors in the absence and in the presence of presumed preservative compound.

The efficiency of a compound (in our model astaxanthin) to recover the chemically induced inhibition of PSII activity is measured as follows:

- 100% of the immobilised PSII activity referred to the I_{drain1} value registered in buffer without herbicide;
- residual immobilised PSII activity referred to I_{drain2} value registered in the presence of chemical inhibitor;
- restored immobilised PSII activity referred to I_{drain3} value registered in the preservative compound (astaxanthin) presence.

In the case of proper preservation of PSII activity I_{drain3} should have a registered value close to that of I_{drain1} .

Technical specifications:

Used technique: field effect

Applied gate potential: 1V

Current domain: 10 pA – 100 nA

Data reading time: 10 ms

Reading time sensor: 1 s