Project Title:

Integrated optical spectroscopy device for fruit growth monitoring.

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Objectives:

The growing demand for non-invasive and cost-effective chemical sensing strategies for monitoring biological and environmental processes is leading to a quest for new optical-based analytical strategies based on miniaturized optical devices. One of the main potential application fields is the monitoring fruit growth, where the technological and organoleptic properties of the products are closely related with biochemical processes that could be indirectly monitored using diffuse reflectance and / or fluorescence.

In this context, the main goal of this project is to provide a fully integrated, miniaturized, stand-alone device capable of performing optical spectroscopy at specific wavelength ranges. The project will require the integration in a single package/device of solid state light sources, photodetectors, optical interference filters and analog/digital circuitry. The integration of such components will be addressed through the following steps:

1- Design and fabrication of an array of thin-film amorphous silicon photodetectors covering the UV-VIS-NIR range. These photodetectors will be fabricated using micro-/nano-fabrication technologies using glass or silicon substrates with photolithographic, etching and chemical vapor deposition (CVD) processes. The fabricated devices will be fully characterized with the measurement of its photoresponse and sensitivity.
2- Fabrication of narrow bandpass interference filters based on thin films. This task consists in designing the different layers (materials and thicknesses that will compose in a structure that follows a Fabry-Perot resonator with dielectric mirrors) of the filters according to the target spectral bands. The layers will be then deposited by ion-beam deposition (IBD) in different substrates (e.g borosilicate glass, amorphous silicon photodetectors, and CMOS photodetectors).
3- Monochromatic solid state light sources from third parties will be used for Multi-chip module assembly. This will be an optical package (open window) placing together light sources and amorphous silicon detectors (advanced packagind solutions may be addressed). A discrete circuitry would have to be thought out for driving the LEDs and signal acquisition of photodetectors which will be used for the test and characterization of spectroscopy device.
4- To meet the integration requirements, CMOS photodetectors will be designed and fabricated including the analog front-end circuitry (Capacitive trans-impedance amplifier, Analog to Digital conversion and serial interface). This task will be executed within the IC design flow environment of a CMOS process (to be defined) providing for a fully integrated detector. Additionally, Filters designed previously will be fabricated on top of CMOS device for complete process integration of proposed spectroscopy device. Test and characterization of such device will be performed (Electrical T&C, Photoresponse and sensistivity) and compared with amorphous silicon detectors (to be replaced within the packaging solution in 3). The final device

will be assembled with control and communication circuitry so it possible to install it in the field for fruit growth monitoring.