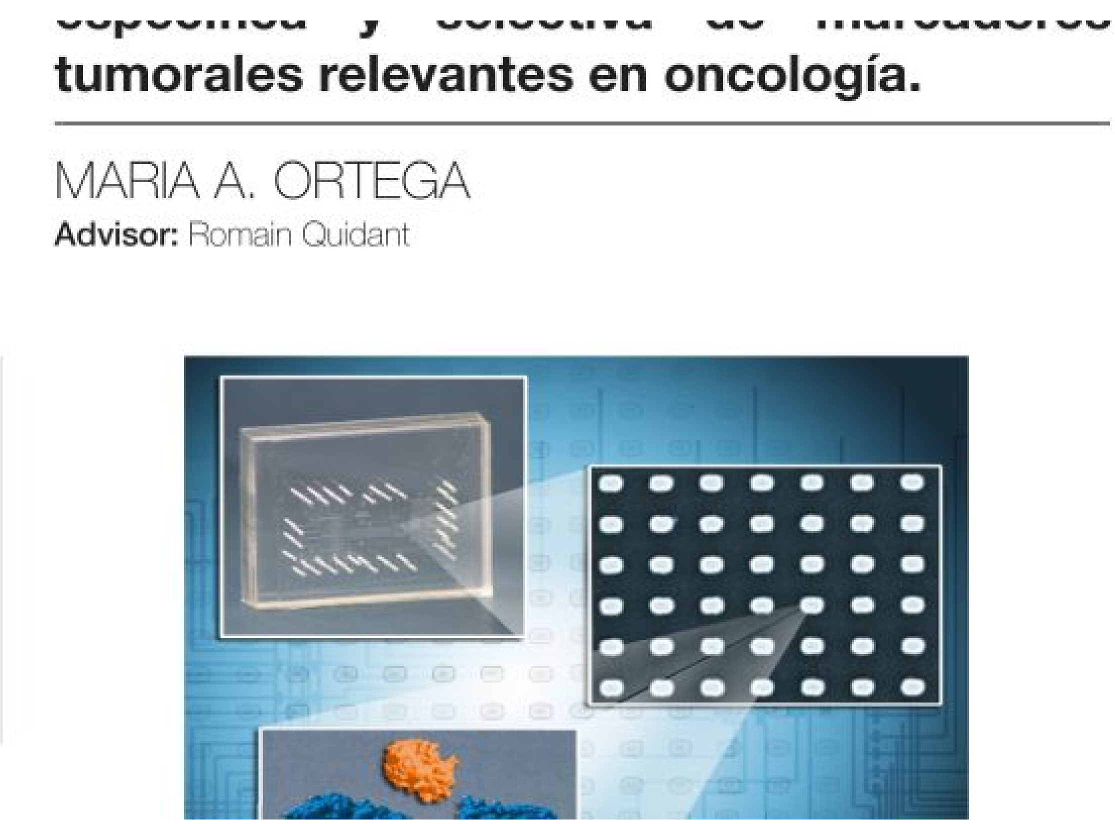

PhD Thesis Defense MARIA ALEJANDRA ORTEGA 'Desarrollo y Validacion de una Plataforma Optofluidica Ultrasensible para la Deteccion Especifica y Selectiva de Marcadores Tumorales Relevantes en Oncologia'

MARIA ALEJANDRA ORTEGA

November 11, 2015

Wednesday, November 11, 11:00. ICFO Auditorium

MARIA ALEJANDRA ORTEGA

Plasmon Nano-optics

ICFO-The Institute of Photonic Sciences, SPAIN

Nowadays cancer is a devastating illness, so its early diagnosis could represent a powerful advantage in the struggle to eradicate it. The most recent technologies allowed the development of sensing platforms that led to the improvement of diagnosis processes, making it possible to detect tumor markers at very low concentrations. However, there are very few applications that measure analytes of clinical interest in real samples with such low concentrations, with the minimum number of pretreatment steps, and with the possibility of performing parallel tests and in real time.

To this purpose, in this doctoral work I developed a platform that combines the most recent advances in plasmonics, microfluidics, nanofabrication and surface chemistry to obtain a highly sensitive and specific biosensing device that is able to detect analyte concentrations of a few ng/mL, with the highest precision and accuracy possible. This device is composed of highly-sensitive nanostructured Localized Sufarce Plasmon Resonance (LSPR) sensors integrated in the microchannels of a microfluidic chip. This Lab-on-a-Chip (LOC) is integrated in an optical platform that allows us to monitor the signals coming from the biorecognition processes that take place on the surface of the LSPR sensors. These sensors are functionalized with a highly selective chemistry that allows the immobilization of the receptors that will detect specifically and selectively the analytes we are interested in.

Regarding the sensor, we describe the nanofabrication technique used to build the sensor as well as the study of different systems and the tests that led to choose an ensemble of gold nanorods as the ultra-sensitive sensing element of the platform. We list all the steps we followed in the preparation of the microfluidics devices and the operation protocols of the final LOC. Lastly, we present a wide study, even though preliminar, of different functionalization methodologies to anchor the receptor.

We initially performed optimizations and a proof-of-principle test by using an antibody system whose interaction is known as it is an IgC/anti-IgC system for both methodologies. We chose the optimal chemistry based on these results to apply it in the preliminary studies for the detection of tumor markers of high relevance for different types of cancer, such as the prostate-specific antigen (PSA), the alpha-fetoprotein (AFP) and other systems of interest.

The obtained results are really promising, as we can detect and quantify these analytes in a very precise way with very low concentration (few ng/mL) in complex matrices like human serum. The platform allows us to detect concentrations and obtain levels of quantification that are comparable to the normal values for blood reported for the analysed systems: this guarantees a promising future for early diagnostics in such systems. Furthermore, we validated these results with techniques, like ELISA, that are widely used for these kind of studies.

The work described in this doctoral thesis is an important and big advance in the development of a new generation of ultra sensitive tools that allow the early detection of very low concentrations of tumor markers: this represent an important progress in cancer diagnosis and treatment, as a consequence, a big step forward towards its complete eradication.

Wednesday November 11, 11:00 h. ICFO Auditorium

Thesis Advisor: Prof. Romain Quidant

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