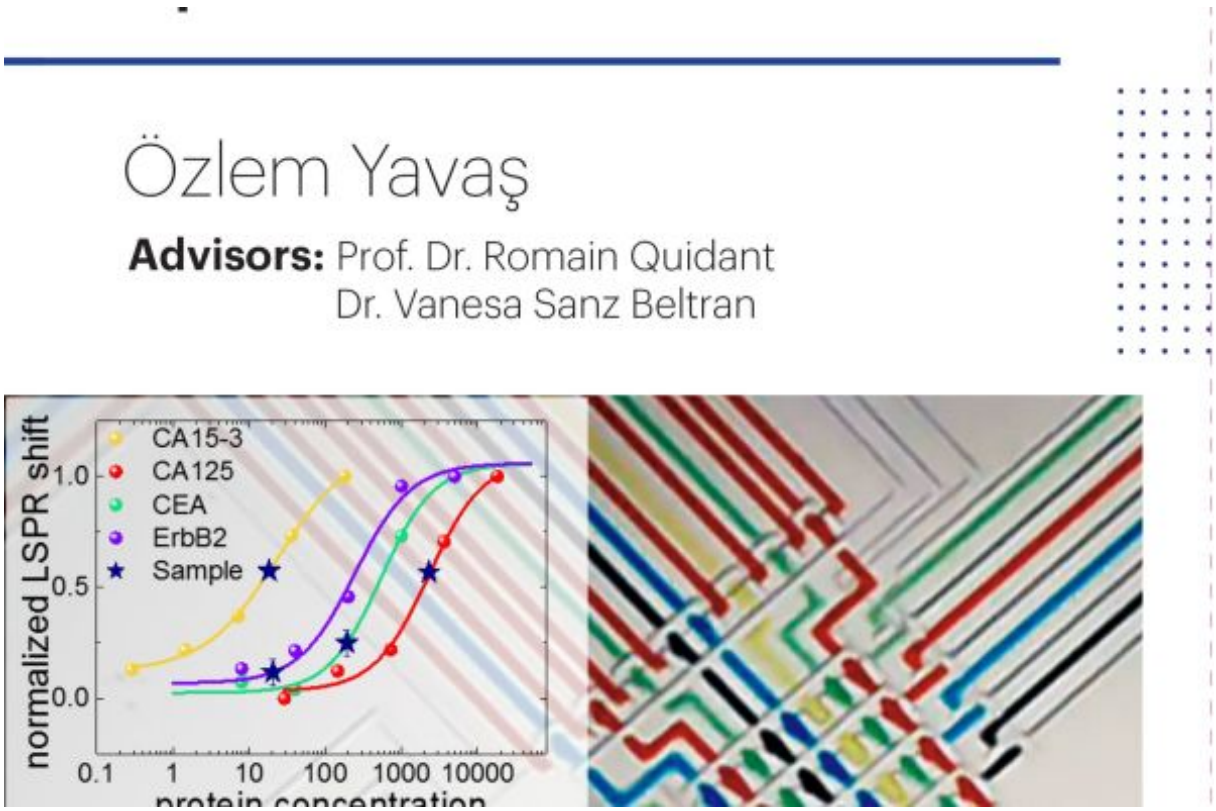

PhD Thesis Defense OZLEM YAVAS 'On-Chip Biosensing Platforms based on Gold and Silicon Optical Nano-Resonators'

OZLEM YAVAS

July 02, 2019

Tuesday, July 2, 11:00. ICFO Auditorium

OZLEM YAVAS

Plasmon Nano-Optics

ICFO-The Institute of Photonic Sciences

Point-of-care (POC) devices are compact, mobile and fast detection platforms expected to advance early diagnosis, treatment monitoring and personalized healthcare, and revolutionize today?s healthcare system, especially in remote areas. The need for POC devices strongly drives the development of novel biosensor technology. Building a small,

fast, simple, and sensitive platform for biomolecule detection is a challenge that relies on the integration of multiple fields of expertise and engineering.

Optical nanoresonators have shown great promise as label-free biosensors because of direct light coupling and sub-wavelength sensing modes. Metallic nanoresonators with localized surface plasmon resonances (LSPR) are already well studied and were proven a solid alternative to the commercialized surface plasmon resonance (SPR) sensors. More recently, dielectric nanoresonators have also gained traction due to the reduced losses and the ability to manipulate both the electric and magnetic components of the incident light.

In this thesis, we advance the field of biosensing and use optical nanoresonators as operative platforms relevant for disease diagnosis and treatment monitoring. By combining different optimized optical nanoresonators, both metallic and dielectric, with state-of-the-art microfluidics and surface chemistry, we have developed and tested several detection platforms.

We first focused on developing a microfluidic lab-on-chip device for multiplexed biosensing utilizing the LSPR of gold nanoresonator arrays. By simultaneously tracking the extinction of 32 sensor arrays, we demonstrated multiplexed quantitative detection of four breast cancer markers in human serum. We showed that with well-optimized immunoassays, a low limit of detection (LOD) can be reached, paving the way towards clinically-relevant POC devices. Additionally, we implemented silicon nanoresonators supporting Mie resonances into functional and clinically-relevant applications. By integrating several arrays of Si nanoresonators with state-of-the-art microfluidics, we demonstrated their ability to detect cancer markers in human serum with high sensitivity and high specificity.

Furthermore, we showed that the fabrication of Si nanoresonator array using low cost and scalable projection lithography leads to sufficiently low limits of detection, while enabling cheaper and faster sensor production for future POC applications. We also investigated the respective role of electric and magnetic dipole resonances and showed that they are associated with two different transduction mechanisms: resonance redshift and extinction decrease.

Our work advances the development of future point-of-care sensing platforms for fast and

low cost health monitoring at the molecular scale.

Tuesday, July 2, 11:00. ICFO Auditorium

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