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Biomolecules detection based on Transmission LSPR

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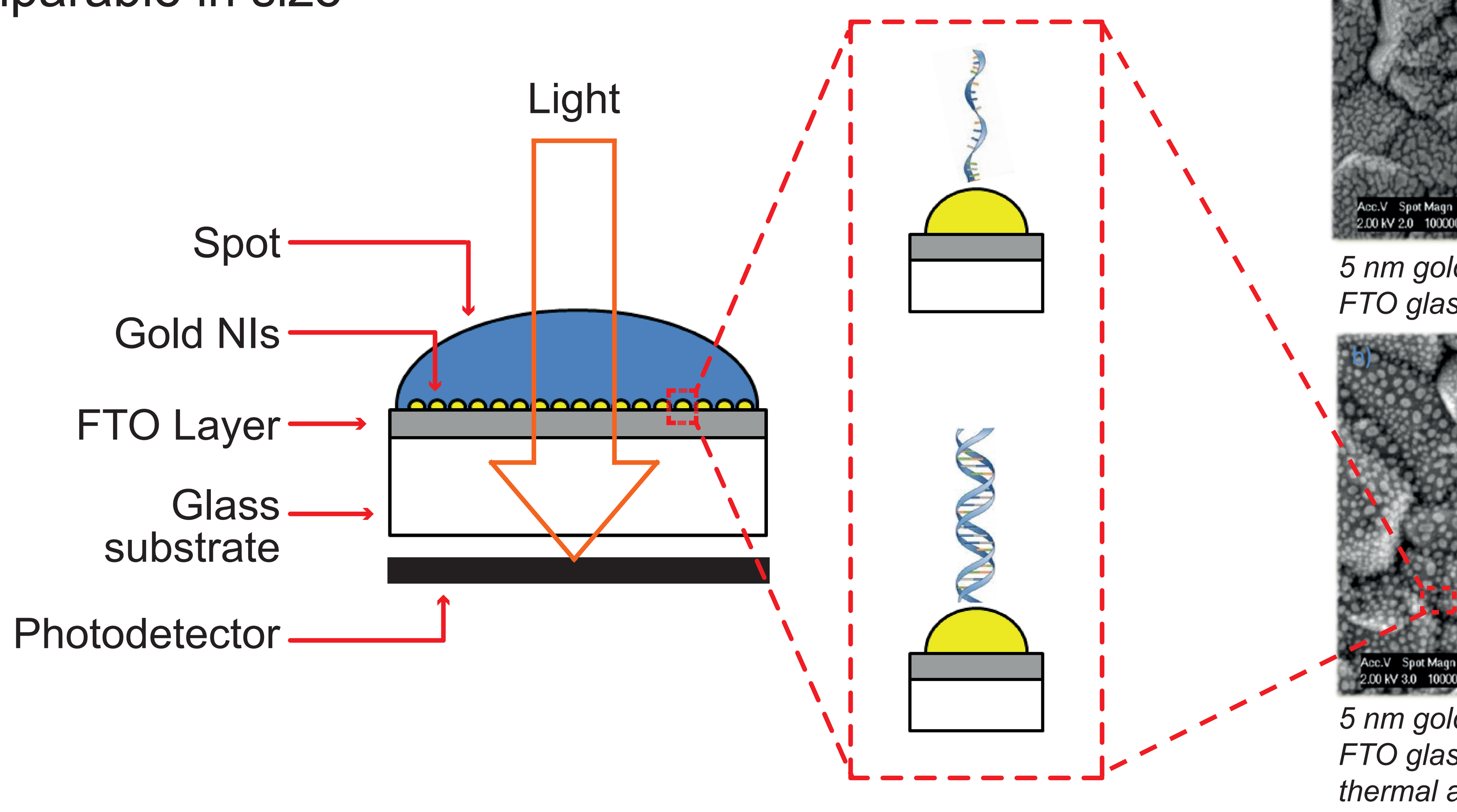
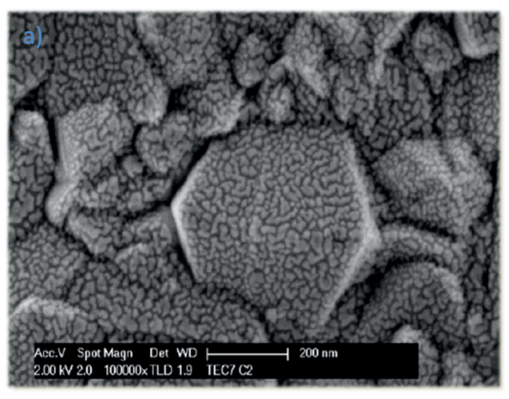
Introduction

Nowadays, fast detection and quantification of biomolecules is a critical issue in many sectors, included health-care, ranging from early diagnostics of diseases to personalized medicine. Among other detection techniques, Surface Plasmon Resonance proved to be a very sensitive and powerful method to detect biomolecular binding of different species, such as proteins, oligonucleotides and viruses.

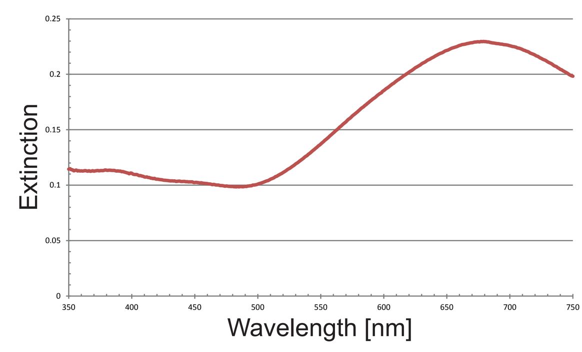
Nanostructures for label-free detection

NanoIslands (NIs) are suitable to probe biomolecules comparable in size

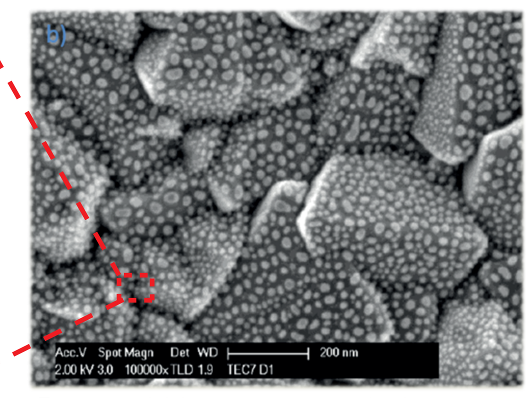




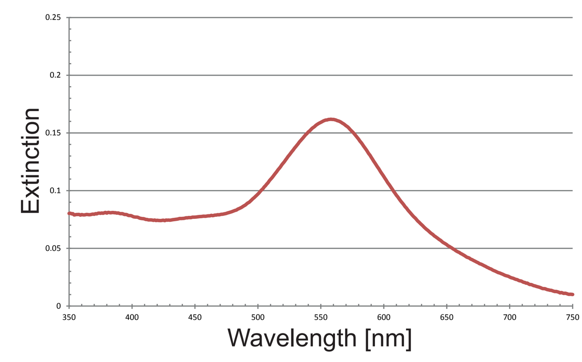
5 nm gold layer evaporated on a FTO glass substrate.



Extinction spectrum of a sample after gold evaporation.



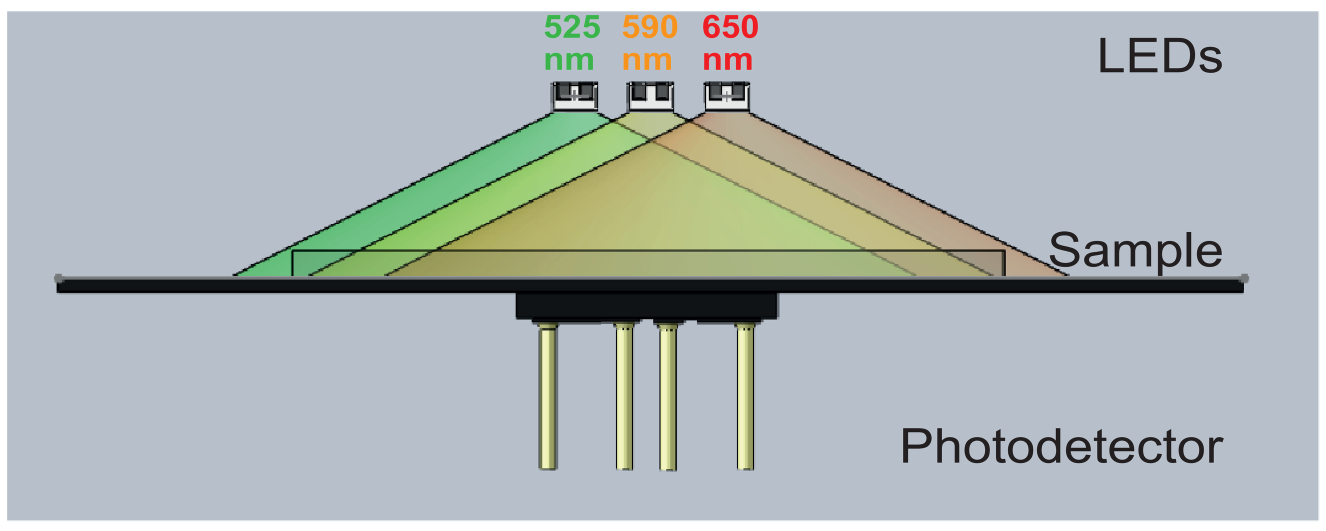
5 nm gold layer evaporated on a FTO glass substrate after mild thermal annealing.



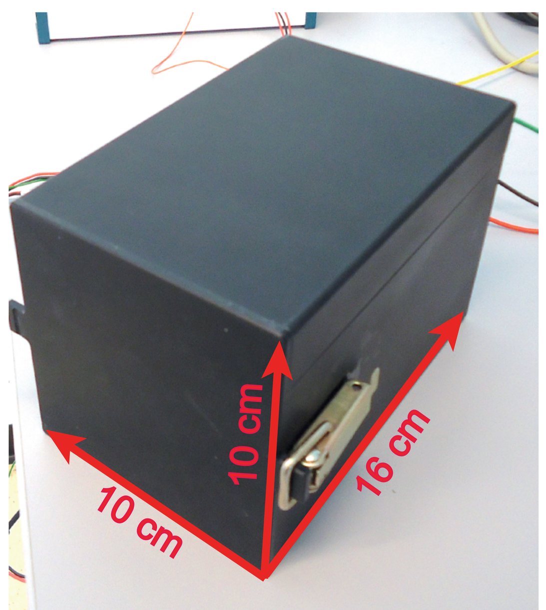
Extinction spectrum of a sample after evaporation and subsequent annealing.

The sensing area is made of gold NanoIslands formed on Fluorine-doped Tin Oxide (FTO) coated glass slides. FTO coated slides are characterized by excellent adhesion properties while showing high optical transmittance and conductivity. A layer of 5 nm of gold was evaporated on FTO surface and then annealed at 200°C.

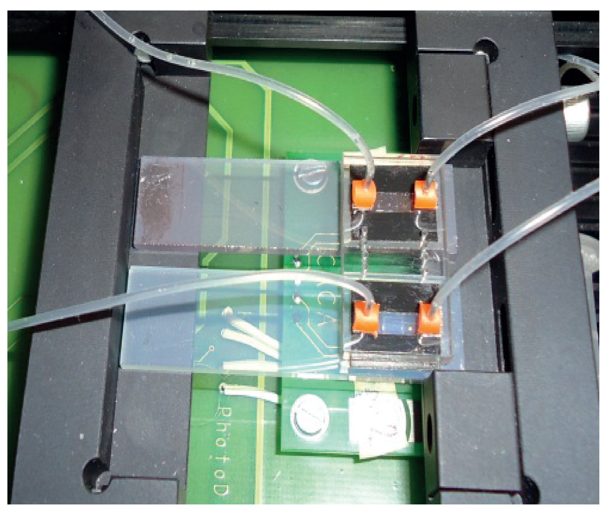
Portable setup for real-time sensing



We developed a device based on low-cost off-the-shelf components, namely, electronically-driven power LEDs and photodetectors, and developed a novel data analysis approach that extracts the peak position of the LSPR spectrum from the measurements performed with a set of three LEDs.

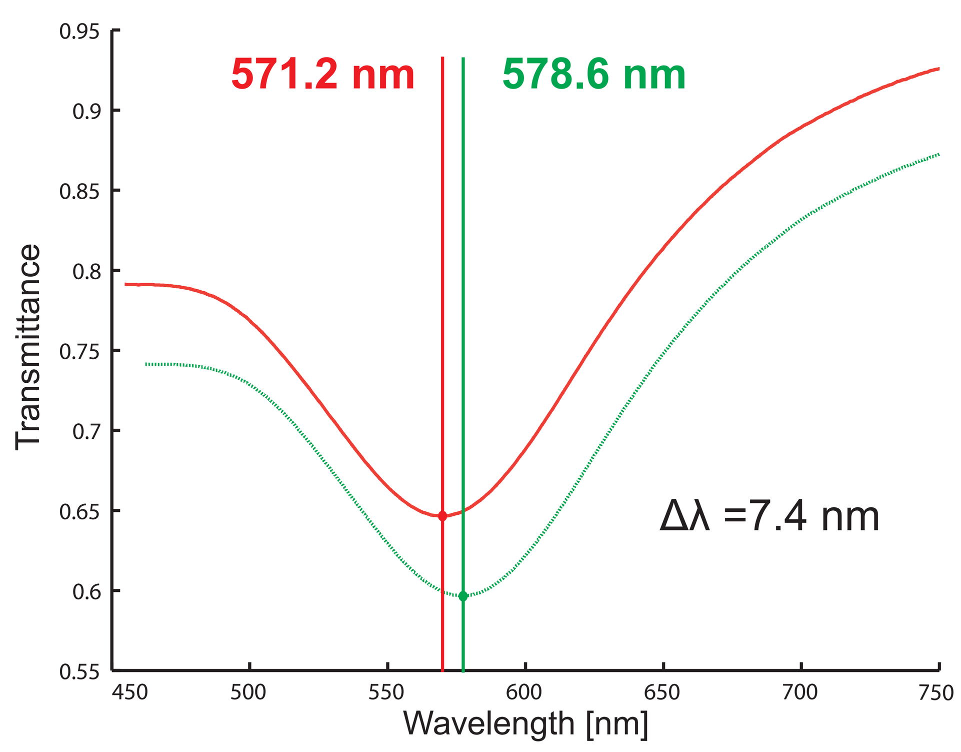


Microfluidics



A microfluidics system consisting of two parallel channels has been built. One of the channels is used as a reference to compensate light drift and other artifacts by a differential measurement.

Measurements



Peak shift of a single strand DNA layer: 7.24 nm with a dispersion of 1.65 nm over 11 samples.
Peak shift reference experiment in PBS 1X: 1.2 nm.

The peak position is estimated from the three measured intensities by means of an algorithm that we developed. A typical surface plasmon transmission spectrum of gold NIs evaporated on a transparent slide is plotted in Figure (red line). The peak is located between 550 nm and 595 nm and red-shifts upon modification of the NIs with layers of organic molecules (green line).

The measurement and extraction of the peak location has been repeated 5 times. The dispersion among the measurements is 0.2 nm. Each measurement has an error bar between 1.6 nm and 1.7 nm given by the standard deviation over 10000 samples collected.

References

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