



HAL
open science

Tunable sensitivity of a biosensor by strain modulation of a gap between gold dimers

Florian Lamaze, William d'Orsonnens, Abdelhamid Hmima, Julien Proust, Louis Giraudet, Eric Finot, Thomas Maurer

► **To cite this version:**

Florian Lamaze, William d'Orsonnens, Abdelhamid Hmima, Julien Proust, Louis Giraudet, et al.. Tunable sensitivity of a biosensor by strain modulation of a gap between gold dimers. Or-nano, Mar 2022, Lyon, France. hal-03688939

HAL Id: hal-03688939

<https://hal.science/hal-03688939v1>

Submitted on 11 Jan 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Tunable sensitivity of a biosensor by strain modulation of a gap between gold dimers

Florian Lamaze¹, William d'Orsonnens¹, Abdelhamid Hmima¹, Julien Proust¹, Louis Giraudet²
Éric Finot³ and Thomas Maurer¹

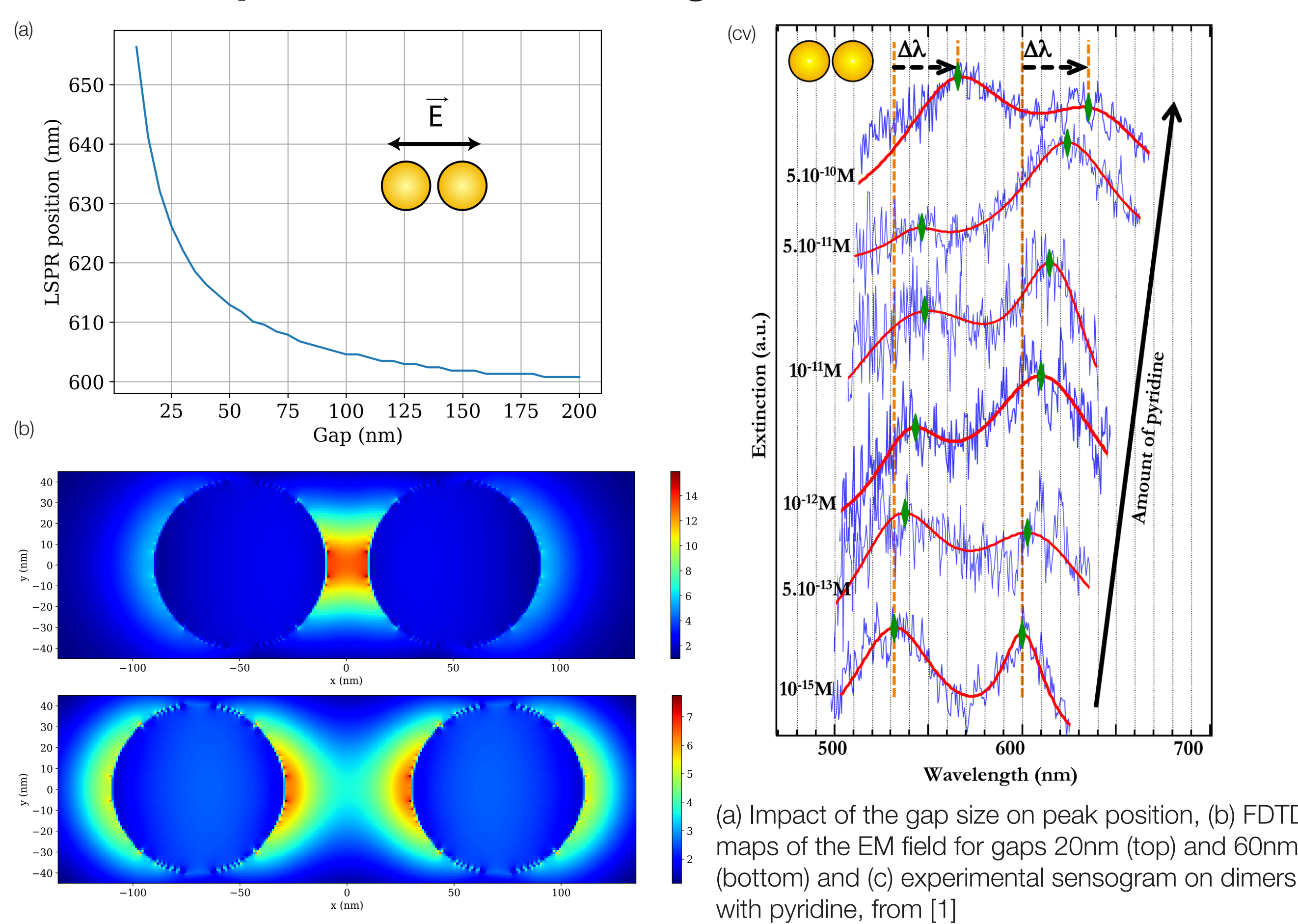
¹Light, nanomaterials, nanotechnologies - CNRS ERL 7004 - Troyes, France

²Nanociences Research Laboratory, EA4682 - Reims, France

³Interdisciplinary Laboratory Carnot of Burgundy, CNRS UMR 6303 - Dijon, France

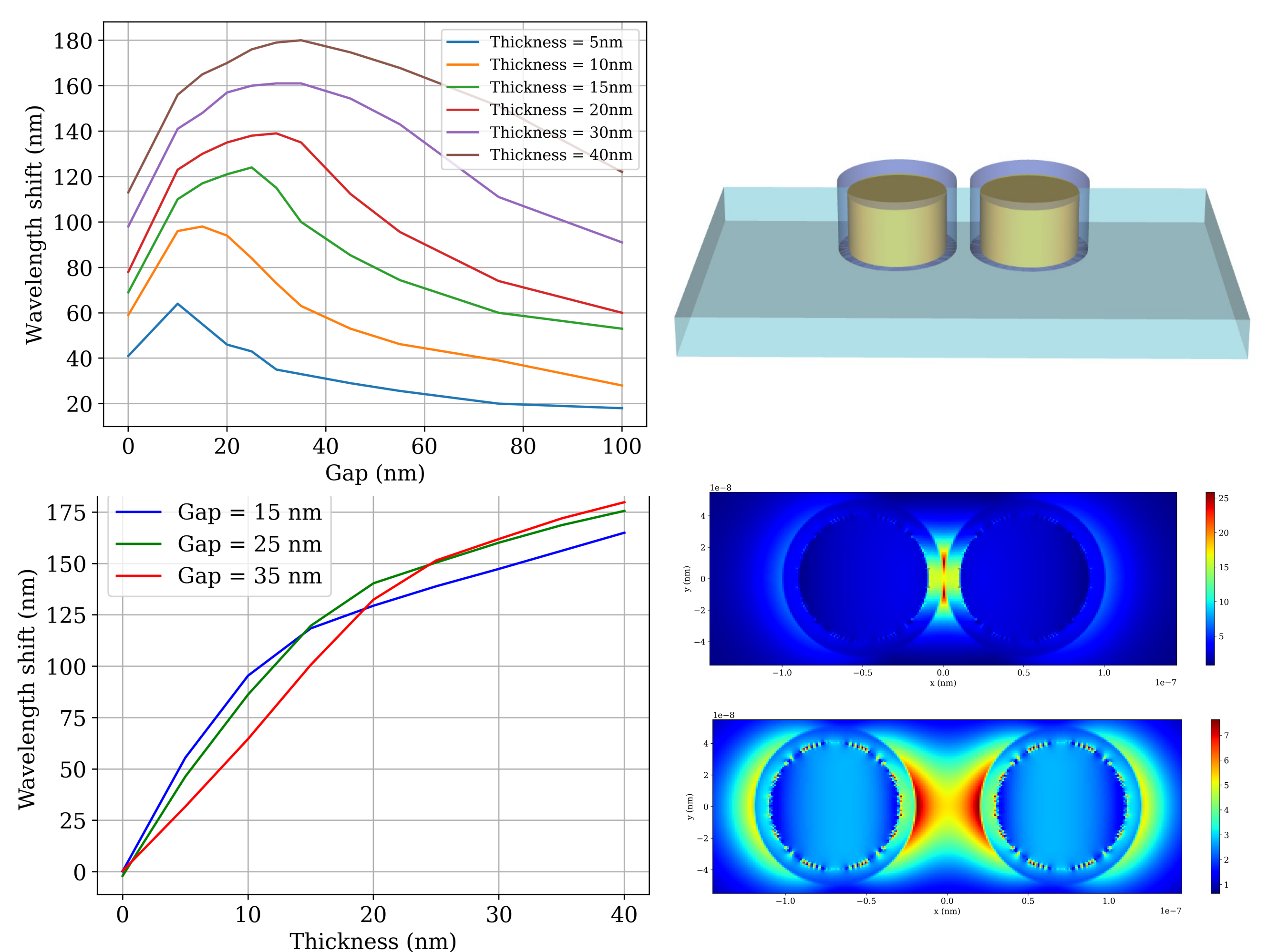
PDMS (Polydimethylsiloxane) **optical and mechanical properties** make it a perfect medium for **plasmonic-based biosensors**. The project presented here takes advantage of the **elastic properties** of PDMS, and of **gold dimers transferred onto it** to increase the detection threshold of **MUA (Mercaptoundecanoic acid)**.

Adaptative sensor: design and simulation

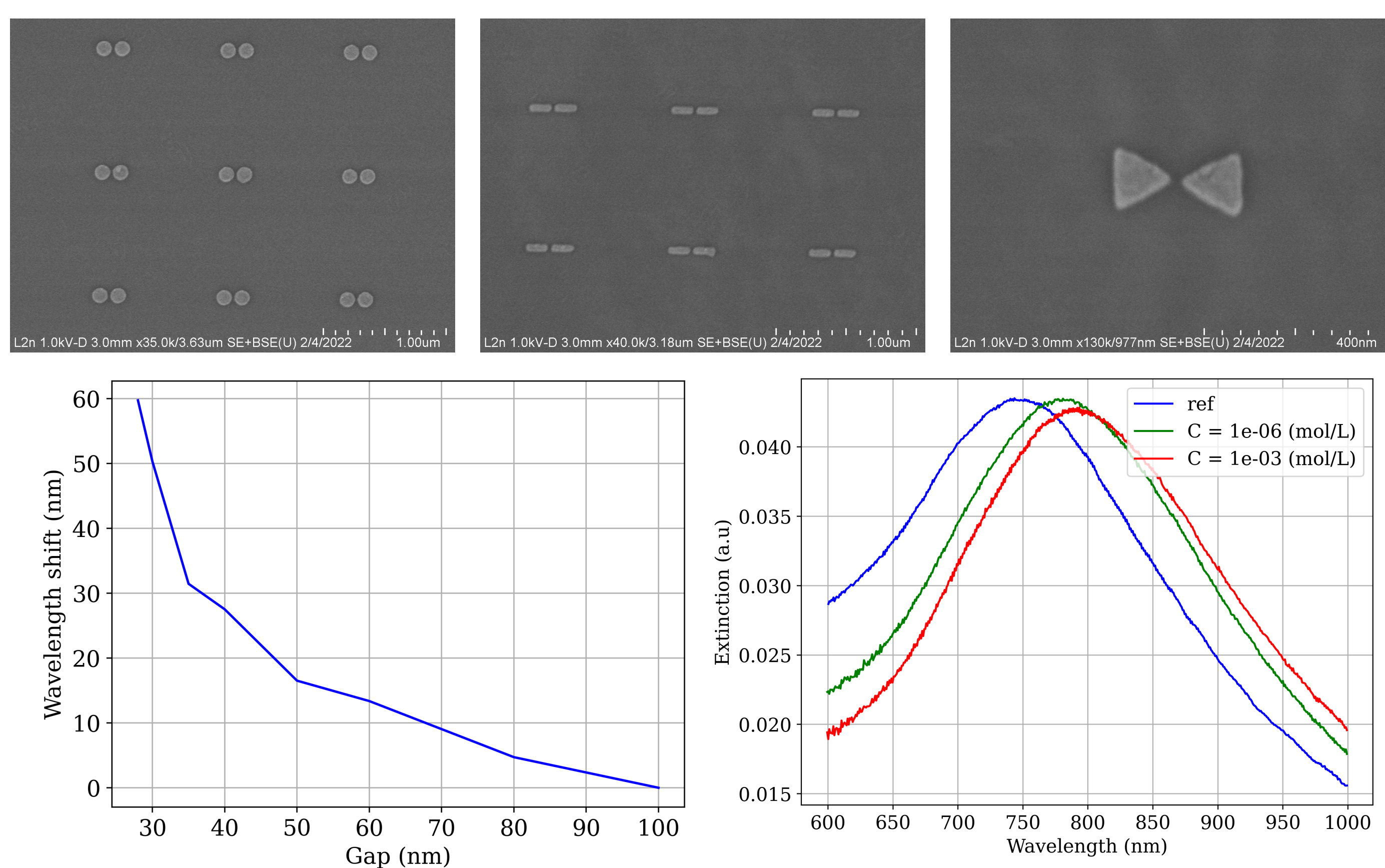


→ EM field is sensitive to the gap mode, which can be used to detect different molecule concentrations.

Simulated addition of MUA on gold dimers

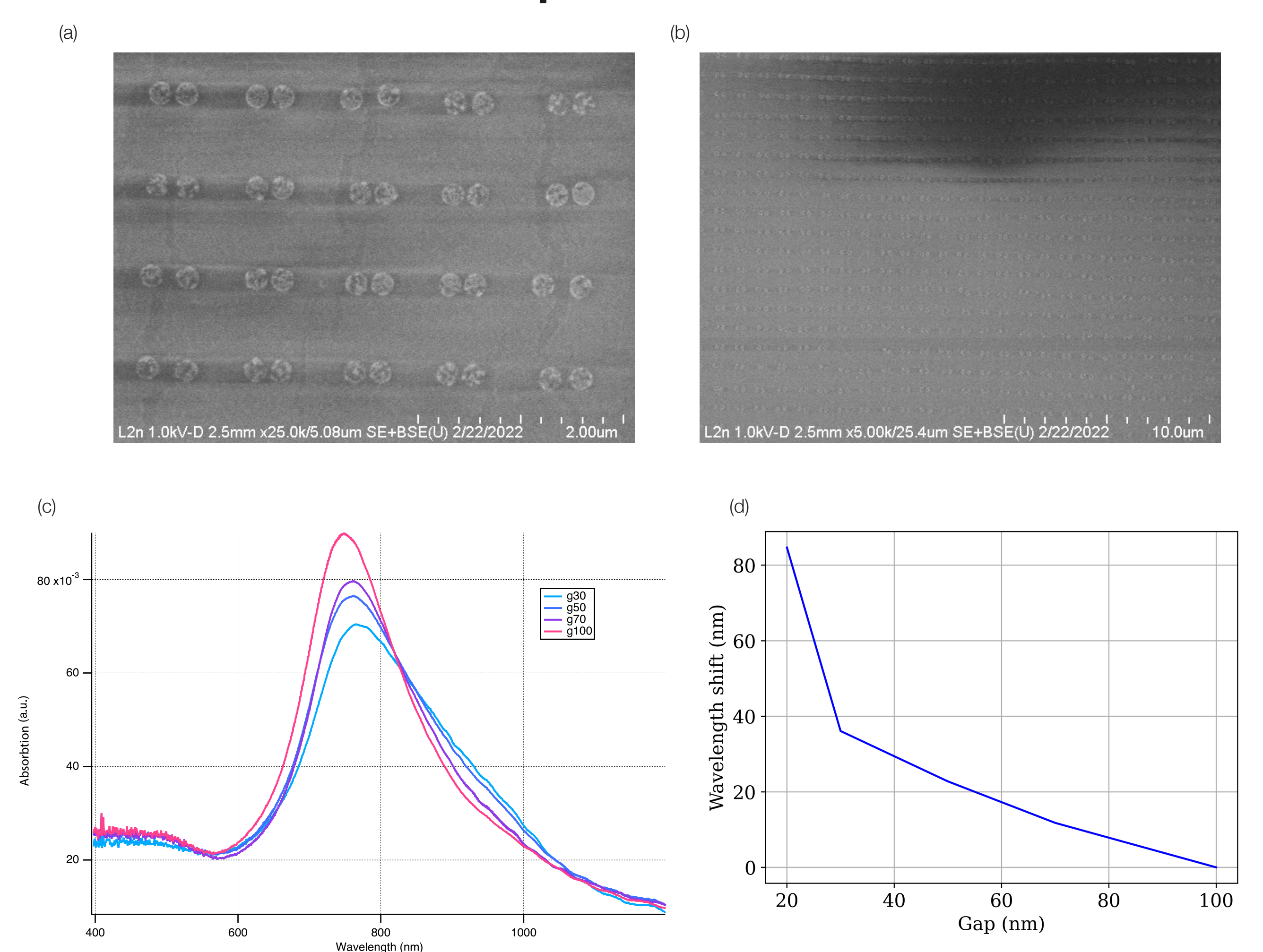


Optical measurements on glass



→ Experimental results on glass show a similar behavior than FDTD simulations. New experiments will be done to select the optimal molecule to avoid sensor saturation.

Transferring structures on PDMS to make an adaptative sensor



(a) and (b) SEM images of gold dimers transferred on PDMS using a chemical etching of a sacrificial layer [2].
(c) Extinction signal of the particles on PDMS: when the gap size decreases we get the expected redshift.
(d) peak position shift while increasing the gap size.

→ Particles can be transferred on a flexible substrate and show similar behaviour than on glass, thus we can expect to get an adaptative sensor by applying strain on the sample.

References

[1] Julien Proust. Etude, caractérisation et optimisation expérimentales de nano-capteurs plasmoniques. Micro et nanotechnologies / Microélectronique. Université de Technologie de Troyes, 2014.

[2] Laible, F., Gollmer, D. A., Dickreuter, S., Kern, D. P. & Fleischer, M. Continuous reversible tuning of the gap size and plasmonic coupling of bow tie nanoantennas on flexible substrates. *Nanoscale* 10, 14915–14922 (2018).