SUPPORTING INFORMATION FOR

Inter-Cavity Coupling Strength Control in Metal/Insulator Multilayers for Hydrogen Sensing

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SECTION 1: Effective Epsilon Near Zero nature of the cavity modes

The knowledge of the complex reflectance coefficients r_p and r_s, associated to the considered structure, allows for the calculation of the ellipsometrical parameters as well. The most important is the so-called pseudo-epsilon $\langle \tilde{\varepsilon} \rangle$, which can be easily calculated by means of the following relation:

$$\langle \tilde{\varepsilon} \rangle = \sin^2(\theta_i)\left[1+\tan^2(\theta_i)\cdot\left(\frac{1-\rho}{1+\rho}\right)^2\right]; \quad \text{(S1)}$$

where:

$$\rho = \tan(\Psi)e^{i\Delta} \quad \text{(S2)}$$

$$\Psi = \arctan^2\left(\left|\frac{\tilde{r}_p}{\tilde{r}_s}\right|\right) \quad \text{(S3)}$$

$$\Delta = \arg(\frac{\tilde{r}_p}{\tilde{r}_s}) \quad \text{(S4)}$$

The results obtained for an incidence angle of 50°, p-polarization and a Mg layer thickness fixed at 20nm, are shown in **Figure S1a**. In particular, in correspondence to the main resonance of the system, which is visible as a strong peak in transmittance (**Figure S1b**) and absorbance (**Figure S1d**) and a dip in reflectance (**Figure S1c**) at about 497 nm, the real part of the pseudo epsilon function undergoes a zero crossing. Such a condition is usually reported as an "effective Epsilon-Near-Zero (ENZ)" resonance [1,2] .

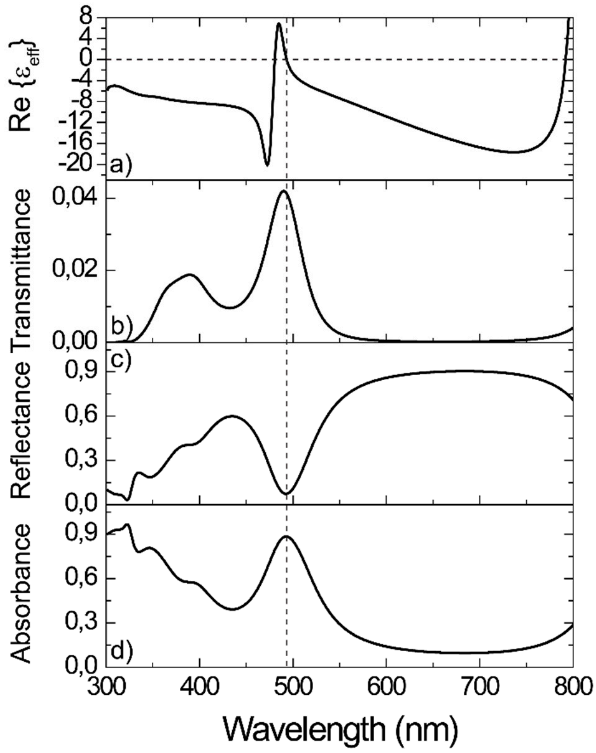

Figure S1: (a) Effective dielectric permittivity calculated from SMM simulated p- and s-polarization scattering parameters at an impinging angle of 50° and 20 nm of Mg layers. P-Polarization (b) Transmittance, (b) reflectance and (c) absorbance calculated as 1-T-R simulated via SMM.

References

1. Caligiuri, V.; Palei, M.; Biffi, G.; Artyukhin, S.; Krahne, R. A Semi-Classical View on Epsilon-Near-Zero Resonant Tunneling Modes in Metal/Insulator/Metal Nanocavities. *Nano Letters* **2019**, *19*, 3151–3160, doi:10.1021/acs.nanolett.9b00564.
2. Caligiuri, V.; Palei, M.; Imran, M.; Manna, L.; Krahne, R. Planar Double-Epsilon-Near-Zero Cavities for Spontaneous Emission and Purcell Effect Enhancement. *ACS Photonics* **2018**, *5*, 2287-2294-2287–2294, doi:10.1021/acsphotonics.8b00121.