

## Supplementary materials

### Plasmon-waveguide resonances with enhanced Figure-of-Merit and their potential for anisotropic bio-sensing in the Near infrared region

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#### 1. Theoretical model

The theoretical calculations of the reflectivity, fields distribution, and the dispersion of the modes were performed using the propagation matrices method. All the materials used in this study are homogenous and isotropic with dispersion that is described below. The full theoretical model of electrodynamic calculations including a detailed algorithm to calculate the fields' intensities distribution are described in reference [1].

#### 2. Materials dispersion

##### 2.1 SF11 dispersion

The prism that was used in the simulations is made of SF11 and its dispersion was calculated using the general Sellmeier equation [2]:

$$\varepsilon_{p(SF11)} = 1 + \frac{A_0 \cdot \lambda^2}{\lambda^2 - B_0} + \frac{A_1 \cdot \lambda^2}{\lambda^2 - B_1} + \frac{A_2 \cdot \lambda^2}{\lambda^2 - B_2} \quad (S1)$$

Where the coefficients  $A_i$  and  $B_i$  are as follows:

$$\begin{aligned} A_0 &= 1.73759695, \quad A_1 = 0.313747346, \quad A_2 = 1.89878101 \\ B_0 &= 0.013188707, \quad B_1 = 0.0623068142, \quad B_2 = 155.23629 \end{aligned}$$

##### 2.2 Silver dispersion

The dispersion of the Ag layers, on the other hand, was modeled by the Lorenz-Drude model. In this model, the contributions of the intra-band and the inter-band transitions are explicitly separated as can be seen in Eq. (S2) [3]:

$$\varepsilon_m = \varepsilon_{free-electrons} + \varepsilon_{bound-electrons}$$

$$\varepsilon_{free-electrons} = 1 - \frac{f_0 \omega_p^2}{\omega(\omega - i\Gamma_0)} \quad ; \quad \varepsilon_{bound-electrons} = \sum_{j=1}^K \frac{f_j \omega_p^2}{(\omega_j^2 - \omega^2) + i\omega\Gamma_j} \quad (S2)$$

In the last two terms,  $\omega_p$  is the plasma frequency,  $K$  is the number of oscillators involved, each with frequency  $\omega_j$ , strength  $f_j$  and life time  $1/\Gamma_j$ . The dispersion parameters of silver are given in table 1.

**Table 1** Silver dielectric constant parameters according to Eq. S2, all the parameters are given in eV units.

$\omega_p$	$f_0$	$\Gamma_0$	$f_1$	$\Gamma_1$	$\omega_1$	$f_2$	$\Gamma_2$	$\omega_2$	$f_3$	$\Gamma_3$	$\omega_3$	$f_4$	$\Gamma_4$	$\omega_4$	$f_5$	$\Gamma_5$	$\omega_5$
9.01	0.845	0.048	0.065	3.886	0.816	0.124	0.452	4.481	0.011	0.065	8.185	0.840	0.916	9.083	5.646	2.419	20.29

### 2.3 SiO2 dispersion

The general Sellmeier equation was also used to calculate the dispersion of the SiO2 layer [2] with the following parametes:

$$\varepsilon_{SiO_2} = 1 + \frac{A_0 \cdot \lambda^2}{\lambda^2 - B_0} + \frac{A_1 \cdot \lambda^2}{\lambda^2 - B_1} + \frac{A_2 \cdot \lambda^2}{\lambda^2 - B_2} \quad (S3)$$

$$A_0 = 0.6961663, \quad A_1 = 0.4079426, \quad A_2 = 0.8974794$$

$$B_0 = 0.0684043, \quad B_1 = 0.1162414, \quad B_2 = 9.896161$$

### References

- [1] Shalabney and I. Abdulhalim, "Electromagnetic fields distribution in multilayer thin film structures and the origin of sensitivity enhancement in surface plasmon resonance sensors", *Sensors and Actuators A: Physical*, 159(1), 24-32 (2010).
- [2] <http://refractiveindex.info/?shelf=glass&book=SF11&page=SCHOTT>
- [3] A. D. Rakic, A. B. Djurišić, J. M. Elazar and M. L. Majewski, "Optical properties of metallic films for vertical-cavity optoelectronic devices", *Appl. Opt.* **37**, 22, 5271-5283 (1998).