imaging using LRM. In a first part of this work we will describe the theoretical principles underlying LRM. In the second part we will discuss modern leakage radiation methods and illustrate the LRM potentialities by analyzing few experiments with SPP waves interacting with 2D plasmonic devices.

II. LEAKAGE RADIATION AND SURFACE PLASMON POLARITONS

In order to describe the theoretical mechanisms explaining leakage radiation it will be sufficient for the present purpose to limit our analysis to the case of a metal film of complex permittivity $\epsilon_1(\omega) = \epsilon_1' + i\epsilon_1''$ ($\omega = 2\pi c/\lambda$ is the pulsation) sandwiched between two dielectric media of permittivity ϵ_0 (substrate) and $\epsilon_2 < \epsilon_0$ (superstratum). This system is theoretically simple and to a good extent experimentally accessible [1, 11]. In the limiting case where the film thickness D is much bigger than the SPP penetration length in the metal (i. e., $D \gtrsim 70$ nm for gold or silver in the visible domain) one can treat the problem as two uncoupled single interfaces. We will consider as an example the interface 0/1 (the media 0 and 1 are located in the domain $z \geq 0$ and $z \leq 0$ respectively). Such an interface will be identified in the following with the plane $z = const.$ in cartesian coordinates. An elementary harmonic SPP wave is actually a TM electromagnetic mode characterized by its pulsation ω and its magnetic field $\mathbf{H} = [0, H_y, 0]$ where the y component can be written

$$\begin{aligned} H_0 &= \alpha e^{ik_x x} e^{ik_{z0} z} e^{-i\omega t} \text{ in the medium 0} \\ H_1 &= e^{ik_x x} e^{ik_{z1} z} e^{-i\omega t} \text{ in the medium 1,} \end{aligned} \tag{1}$$

and where $k_x = k_x' + ik_x''$ is the (complex valued) wavevector of the SPP propagating in the x direction along the interface. $k_{zj} \equiv k_j = \pm\sqrt{[(\omega/c)^2\epsilon_i - k_x^2]}$ are the wave vectors in the medium j =[0 (dielectric), 1 (metal)] along the direction z normal to the interface. By applying boundary conditions to Maxwell's equations one deduces additionally $\alpha = 1$ and

$$\frac{k_1}{\epsilon_1} - \frac{k_0}{\epsilon_0} = 0, \tag{2}$$

which implies

$$k_x = \pm(\omega/c)\sqrt{\frac{\epsilon_0\epsilon_1}{\epsilon_0 + \epsilon_1}} \tag{3}$$

$$k_j = \pm(\omega/c)\sqrt{\frac{\epsilon_j^2}{\epsilon_0 + \epsilon_1}} \tag{4}$$