

## Tunable light transmission by cascading two metallic layers engraved with subwavelength Annular Aperture Arrays

Y. Poujet, J. Salvi and F. Baida\*

Institut FEMTO-ST (UMR 6174), Département d'Optique P.M. Duffieux  
Université de Franche-Comté, 25030 Besançon Cedex, France.

\* fbaida@univ-fcomte.fr

Transmission through Annular Aperture Arrays (AAA) is based on the guiding of light inside the apertures due to a guided mode which can be excited with a linear polarization. The cutoff of this mode is red-shifted when we consider a real metal instead of a perfect electric conductor [1, 2]. The transmission can theoretically reach 90% in the visible range and is then 10 times larger than what it can be obtained with simple aperture of the same diameter [3].

We will show first some theoretical results obtained with our home made code based on the Finite Difference Time Domain (FDTD) algorithm. We will compare the transmission spectrum of a double structure (2 layers) with the transmission of a single metallic layer. An additional red-shift can be obtained with this double structure i.e. light transmission can occur beyond the cutoff wavelength of the guided mode. This effect is due to interference induced by the Fabry-Pérot interferometer composed of the two metallic layers. Tuning of the transmission is then obtained by simply changing the distance between the two layers or by changing the refractive index of the intermediate medium. Numerous applications, using this configuration, can be conceived either in the optical or in the millimeter-wave domains.

In a second part, we will present some experimental results concerning the transmission through a single silver layer with annular apertures exhibiting a transmission around 90 % in the visible range. These results show a good agreement with theoretical predictions.

[1] F.I. Baida and D. Van Labeke, *Opt. Commun.*, **209**, 17 (2002)

[2] F.I. Baida *et al.*, *Applied Phys. B*, **79**, 1 (2004)

[3] T.W. Ebbesen *et al.*, *Nature*, **391**, 667 (1998)