NEARFIELD EFFECT IN A NANOTUBE/NANOPOR ARRAY SYSTEM FOR APPLICATION IN EWOD DEVICES THAT ARE OPERATING IN THz REGION

Lilian Sirbu[1], Vladimir Sergentu[2], Rodica Voicu[3], Ion Tiginyanu[1], Veaceslav Ursaki[2]

[1]"D. Ghitu" Institute of Electronic Engineering and Nanotechnologies, Academiei str., Chisinau, Moldova
E-mail: sirbu_lilian@yahoo.de
[2]Institute of Applied Physics, Academy of Science of Moldova, 5, Academiei str., MD-2028 Chisinau, Moldova
[3]National Institute for R&D in Microtechnologies - IMT Bucharest, Erou Iancu Nicolae 126 A Str., Romania

Abstract–*We present a theoretical model for propagation of EM wav. in various kinds of structures such as arrays of monolayer cylinders, multilayer cylinders, non-metallized and metallised pores. An analytical method was developed for the deduction of dispersion law in a multilayer nanocilinder array system. The proposed structure can be used to focus the EM wave. The simulation was performed by using FDTD model (OptiFDTD software) for conical InP pores prepared by electrochemical technique. The results of this work demonstrate the existence of ultrashort modes at low frequencies in porous systems.*

Keywords: *nanopore, nanocylinder, nearfield, THz, FDTD, EWOD*

1. INTRODUCTION

Terahertz radiation bridges the gap between the microwave and optical regimes, and offers significant scientific and technological potential in many fields. Neither conventional metal waveguides for microwave radiation, nor dielectric fibres for visible and near-infrared radiation can be used to guide terahertz waves over a long distance, owing to the high loss from the finite conductivity of metals or the high values of the absorption coefficient of dielectric materials in this spectral range.

Recently, there has been an increased interest in the search for a good waveguide for the transportation of terahertz radiation [1-5]. The investigation has been done for the propagation behaviour of THz surface-wave pulses along bare and dielectrically coated metal wires [6-8]. Frequency-dependent attenuation and dispersion parameters are determined in the range of 0.02 THz to 0.4 THz with an optoelectronic time-domain measurement setup [6]. On the other hand, it is necessary to focus the THz radiation in the nearfield region for EWOD integration or MEMS/MOEMS implementation. Different structures have been used for this purpose. The concentric rings as a three-dimensional phase antenna have been demonstrated [9], and image spots separated by several microns from the lens have been produced. Tight focal spots are obtained for silicon or gold rings patterned in a silica matrix. Another way to reach an efficient focusing of EM radiation is to use conical metal wires [10]. The tapered arrays of thin metallic wires can manipulate electromagnetic fields on the subwavelength spatial scale. There are two types of nanoscale imaging applications using terahertz and mid-infrared waves [11]: image magnification and radiation focusing. First, the tapered wire array acts as a multipixel TEM endoscope by capturing an electromagnetic field profile created by deeply subwavelength objects at the endoscope's tip and magnifying it for observation. Second, the image of a large mask at the endoscope's base is projected onto a much smaller image at the tip.

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2. PROBLEM STATEMENT

The fabrication of nanoporous templates within technological processes allows to obtain various kinds of cylinders arrays. Between them one can distinguish simple and metalized pores, simple nanotubes and multilayer nanocylinders (see Figure 1).

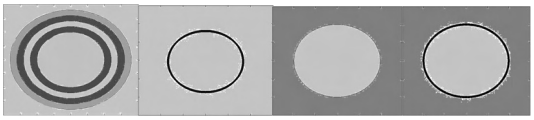

Fig. 1. The cross sections for different types of multi-cylinder: 5-layer cylinder, the simplest type of nanotube, a cylindrical pore, metallized pore (different intensity of grey colour denotes different values of the dielectric constant).

Our aim is to deduce the convenient analytical formulas and their solution in