Modelling, fabrication and characterisation of THz fractal meta-materials

Xiao, S.; Zhou, L.; Malureanu, Radu; Lavrinenko, Andrei; Cooke, David; Jepsen, Peter Uhd

Published in:
Proceedings of the fifth International Conference on Nanophotonics

Publication date:
2011

Modelling, fabrication and characterisation of THz fractal metamaterials

S. Xiao[1)], L. Zhou[1)], R. Malureanu*[2)], A. Lavrinenko[2)], D. Cooke[2)], P. Uhd Jepsen[2)],

1) Physics Department, Fudan University, Shanghai 200433, China
2) DTU Fotonik, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark
*Email: rmal@fotonik.dtu.dk

Abstract

We present theoretical predictions, fabrication procedure and characterisation results of fractal metamaterials for the THz frequency range. The characterisation results match well the predicted response thus validating both the fabrication procedure as well as the simulation one. Such systems show the possibility of fabricating new THz devices like polarisers, polarising beam splitters etc.

Metamaterials are specially designed structures that present unexpected properties in certain frequency ranges. Such properties can lead to system behaviour that is not encountered in natural occurring materials thus expanding the control possibilities of the electromagnetic field. Our paper presents modelling, fabrication and characterisation of such materials in the THz.

Following theoretical predictions [1] we conceived a fabrication procedure [2] for free standing metal membranes (Fig 1a) that can be used as e.g. polarisers, field enhancers etc. The membranes were characterised using THz Time Domain Spectroscopy [3] showing characteristics similar to the ones predicted by theory, among which: high transmission selectivity both in frequency as well as polarisation, independence of the incident angle (Fig. 1b), possible coupling to surface waves at certain frequencies.

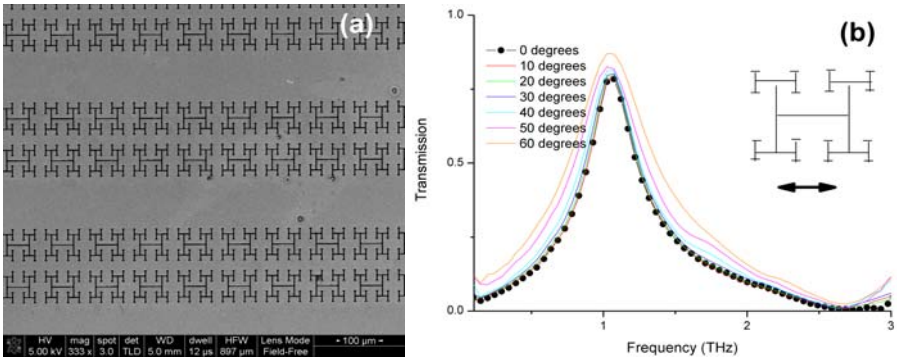

Fig.1 (a) – Fabricated THz metamaterial membrane, (b) – Obtained transmission spectra showing the transmission spectra independence on the incident angle

We present here a complete modelling to characterisation cycle for a fractal THz metamaterial membrane that can be used for various purposes from polarisers and polarising beamsplitters to field enhancers usable to obtain new and interesting modulation and sensing possibilities.

References

[1] X. Huang, S. Xiao, D. Ye, J. Huangfu, Z. Wang, L. Ran, and L. Zhou, *Optics Express*, v**ol. 18(10)**, pp. 10377, 2010

[2] R. Malureanu, P. Uhd Jepsen, S. Xiao, L. Zhou, D. Cooke, A. Andryieuski and A. Lavrinenko, *Proceedings of SPIE*, **vol. 7711**, pp. 77110M, 2010

[3] P. Uhd Jepsen, D. G. Cooke, and M. Koch, *Laser & Photonics Review*, **vol. 5**, pp. 124-166, 2011