Fabrication and optical characterization of Bragg mirror formed by porous silicon under electrochemical etching

Ellen Christine de Souza Galvão[1], Luiz Angelo Berni[2], Antonio Fernando Beloto[2]

[1]Universidade Federal de São Paulo, [2]Instituto Nacional de Pesquisas Espaciais

e-mail: ellen.eln16@yahoo.com.br

Bragg mirror is based on the principle of light interference from different layers. The mirror is formed by a periodic structure composed of thin layers of alternating high refractive index with low refractive index. By careful choice of the layers thickness it is possible to produce high quality reflectors for wavelengths in the photonic stopband. The layers have a thickness of a quarter wavelength.

Porous silicon can be formed by electrochemical etching of a crystalline silicon wafer in hydrofluoric acid solutions under a controlled current density. The pore size, thickness, refractive index, porosity and microstructure of pores can be controlled by the manufacturing conditions and the doping conditions of the initial wafer. Since in the electrochemical etching of the porous silicon the current flows preferentially toward the deepest pores it is possible to produce layers of different refractive index by modulating the current density during the etching.

In this work, the porous silicon were prepared from low resistivity (0.01 – 0.02 Ω.cm) p-type monocrystalline silicon wafers (100) using different current density in order to obtain thin layers and produce Bragg mirrors. The dependence of thickness, refraction index and porosity were investigated for each current density. The Bragg mirrors were produced in the VIS range composed by dozen of layers. Structural and optical properties of the fabricated Bragg mirrors were investigated using high-resolution scanning electron microscopy and liquid spectroscopy infiltration method [1].

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References

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