VERTICAL MULTILAYER STRUCTURES BASED ON POROUS SILICON LAYERS FOR MID-INFRARED APPLICATIONS

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The implementation of a Mid-InfraRed (Mid-IR) silicon (Si) photonic transducer with broad Mid-IR transparency (up to 8 µm by taking into account Si transparency) is a challenge that could find applications in spectroscopic sensing and environmental monitoring. This paper demonstrates the fabrication of vertical porous silicon (PSi) multilayer structures on Si substrates and their sensing potential in the Mid-IR wavelength range notably near the cut-off band of Si due to its absorption up to 8 µm. Bragg reflector and vertical cavity on P^+ silicon substrates for applications in spectroscopic sensing in the Mid-IR wavelength range are fabricated and optically characterized. The complex refractive index of PSi single layers is measured. Optical vertical devices are then fabricated and characterized by Fourier Transform InfraRed (FTIR) spectrophotometry. This work demonstrates the use of electrochemically prepared Bragg reflectors with reflectance as high as 99% and vertical cavity based on PSi layers (figure 1a) operating in the Mid-IR spectral region (up to 8 µm). Experimental reflectance spectra of the vertical cavity structures (figure 1b) are recorded as a function of air exposure duration after thermal annealing under nitrogen flux (N_2) and results demonstrate that these structures could be used for spectroscopic sensing applications in the Mid-IR (2-8 µm) by grafting specific biomolecules on the PSi internal surface and by fabricating optical integrated waveguides.

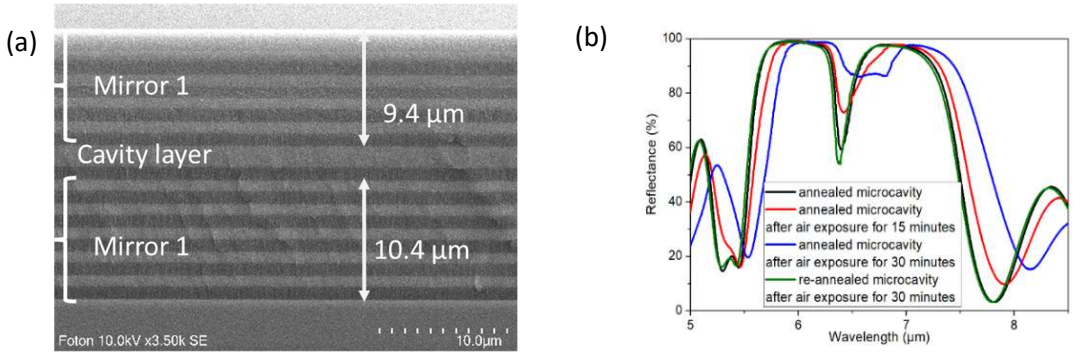

Figure 1: (a) Scanning electron microscope micrograph (cross section) of vertical micro-cavity and (b) Evolution of the experimental reflectance spectra of the same micro-cavity structure as a function of exposure duration to air after annealing at 300°C of the structure under N_2.

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