

An optical screen for light guiding in the vertical direction

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1. Introduction

Display devices with light guiding in the vertical direction with respect to the screen surface could be used for information security. Also the vertical light guiding could be used for interchip optical interconnects [1]. We have developed the optical screen based on macroporous alumina or macroporous silicon membrane which can provide the light propagation in the vertical direction while the other directions are prohibited.

2. Experimental Setup

Experimental structures were created by the magnetron sputtering deposition of the Al/Si film with 0.1 μm thickness and the subsequent deposition of pure Al film with 1.0 μm thickness on the n-type monocrystalline silicon wafer. The deposited films were subjected to anodic treatment in a 20 % aqueous solution of orthophosphoric acid via preformed photoresist masks at their surfaces that resulted in the formation of the composite film of nanostructured silicon embedded in the alumina matrix. Not anodized areas protected by the photoresist mask have formed metal electrodes between anodized regions. Thus sets of Schottky contacts have been formed that can emit light in avalanche breakdown mode (LED). Along with the mentioned above structures microchannel wafers of 100-150 μm thickness with through-holes (vias) with diameters of 5-6 μm are also produced.

3. Results and Discussion

Microchannel silicon wafer or microchannel alumina membrane has been formed as was described in [1] and used for light guiding in the vertical direction. The light source was either nanostructured silicon LED or laser beam with wavelength in the visible region of the spectrum for example 532 nm. The silicon photodetector has been used for the light registration. Figure 1 shows optical microscopy images of the microchannel silicon wafer providing an optical signal transmission in the vertical direction relative to the surface of the chips.

Figure 2 shows the scattering indicatrice of laser beam propagation through microchannel silicon wafer. The indicatrice of light propagation for the macroporous alumina membrane with the same pore sizes is similar. Thus we have demonstrated light guiding in the vertical direction.

4. Conclusion

We have demonstrated the ability to provide the

propagation of radiation only in the vertical direction. The fabricated structure opens up new possibilities for the development of silicon photonics.

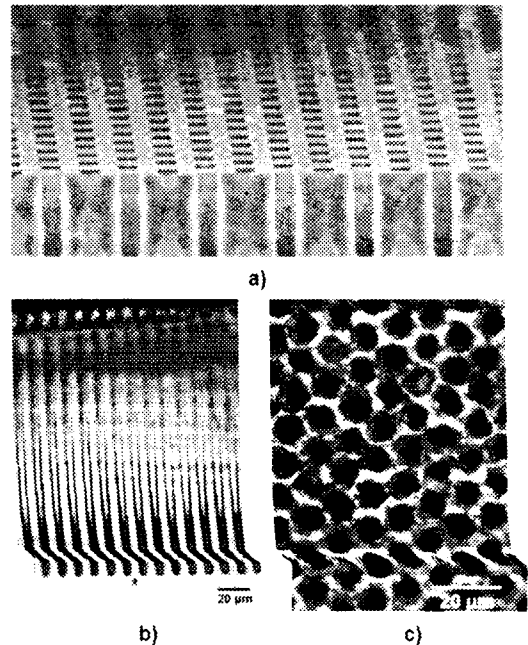


Figure 1: Cross-section (a, b) and bottom (c) images of the silicon microchannel silicon wafer used for vertically oriented display screen

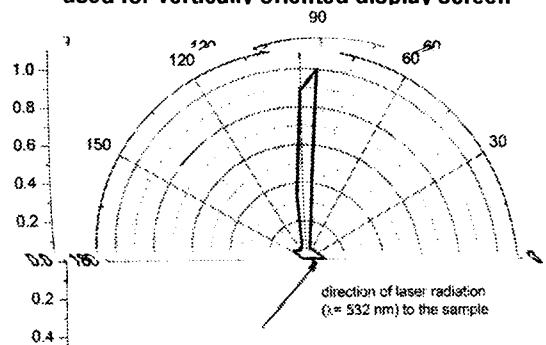


Figure 2: Indicatrice of vertically oriented display screen

5. References

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