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ZINC OXIDE

for 1550nm sensing applications

INTRODUCTION

Zinc oxide (ZnO) can be used as a smart material in (among other things) electro-optical or piezo-electrical devices. Up to now LioniX has focused material research on the electro-optical properties of ZnO, for application in integrated optical (IO) circuits. An example of an IO circuit, which utilises the electro-optical properties of ZnO, is the integrated optical Mach-Zehnder Interferometer (IO-MZI).

LioniX has optimized ZnO deposition parameters to optimize optical performance wavelengths of 633, 850 and 1550 nm.

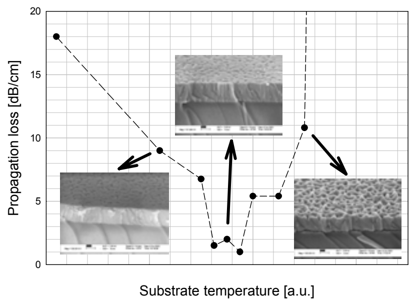
ZINC OXIDE TECHNOLOGY

ZnO is deposited using a DC triode sputtering machine owned by LioniX, see photograph below.

The growth temperature and post-deposition annealing have a strong influence on the resulting optical losses (absorption per unit propagation length, dB/cm). The growth temperature has been optimized; see the graph below comparing various situations.

In the region where the absorption losses are minimal, post-deposition annealing is no longer required. The electro-optical coefficient of ZnO is not influenced significantly. This was checked using the Teng-Man technique.

Figure 1 Propagation loss of ZnO.



The magnitude of the electro-optic effect of ZnO is 1.4 pm/V. The structure of *as deposited* ZnO on top of amorphous SiO_2 or Si_3N_4 is preferentially *c*-axis oriented polycrystalline. Therefore ZnO does not require poling for activation of the electro-optical or piezo-electrical properties. Other electro-optical crystals such as P(L)ZT or $BaTiO_3$ can be grown preferentially *c*-axis oriented only on top of special materials such as $SrTiO_3$ which are much more expensive and available only in small sizes. Electro-optical polymers always require poling after deposition, have adhesion problems, and do not allow temperatures above 150 °C in further processing.

Another convenient property of ZnO is that its refractive index is very close to that of LPCVD Si_3N_4, which allows fabrication of very high contrast IO waveguiding structures with a mix of Si_3N_4 and ZnO as core layer material.

REFERENCE

Heideman, R.G., Lambeck, P.V., SENSORS AND ACTUATORS B, VOL 61, 1999

Teng, C.C., Man, H.T., Appl.Phys.Lett., Vol.56, No.18,30 April 1990

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LIONIX MISSION STATEMENT

LioniX is a leading provider in development and small to high volume production of leveraging and innovative products based on microsystem technology and MEMS. Our core technologies are integrated optics and microfluidics.

FROM WHOM WE WORK

Our customers operate in telecom, industrial process control, life sciences and spaces markets and include OEM's, multinationals, VC start-up companies as well as research institutions from around the world.

OUR BUSINESS FORMULA

LioniX offers design for manufacturing and horizontal integration by partnering with MEMS/MST foundries and suppliers of complementary technologies. Cooperations are based on subcontracting, licensing of IP or joint ventures.

TECHNOLOGY

IPR

LioniX has an IPR agreement on technology with the world-renowned MESA+ institute and is rapidly building up a firm IPR position in its core competences integrated optics and microfluidics.

Facilities

LioniX uses state-of-the-art facilities of MESA+ Institute, as well as private facilities for our core technologies.

Our processes are performed on 100 mm silicon, borosilicate, quartz and other substrates.

- CVD deposition
- PECVD silicon-oxynitrides
- LPCVD Silicon-rich-nitride
- LPCVD Silicon-nitride
- LPCVD polysilicon

OCMMM PROJECT