Designing Ecological Monitoring using IOS system

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***Abstract*: Integrated optics is a system of light-controlling components combined into a single device. The ultimate aim is to create miniature optical circuits similar to the silicon chips that have revolutionized the electronics industry. However, there exists a growing interest in the development of more and more complex integrated optical devices. In IOS we distinguish between optical integrated circuits, which perform functions similar to electronic circuits in communications systems, and planar optical devices, which are integrated optical systems other than communication systems. The advantage of the optical approach however is that data can be processed at much higher speeds. The goal of Integrated Optical Sensor (IOS) is to develop miniaturized optical devices of high functionality on a common substrate. The state-of-the-art of integrated optics is still far behind its electronic counterpart. Today, only a few basic functions are commercially feasible. The transmission and processing of signals carried by optical beams rather than by electrical currents or radio waves. When the development of the laser first provided a stable source of coherent light for such applications.**

***Keywords*: IOS, Integrated Circuits, Optics, Optical beams, coherent light**

I. Introduction:

Integrated optics is analogous to the integrated electronics that has had such a profound impact on society over the last 50 years through the phenomenal growth in the use and capabilities of silicon chip based electronics. Integrated Optical Sensor (IOS) circuits Researchers hope to put wave guides, modulators, switches, and other active optical functions onto various substrates[1]. It is visualized that thin films and micro-fabrication technologies can suitably be adopted to realize optical counterparts of integrated electronics for signal generation, modulation, switching, multiplexing and processing. It replaces wires with waveguides, and can integrate light sources, active and passive light processors, detectors, etc to enable full optical system on a chip capability. It exploits the same potential economies of scale as integrated silicon electronics to reduce costs and increase functionality, whilst in the case of optics providing other side benefits such as mechanical stability and robustness that make possible types of optical systems that cannot be implemented any other way. In optical integrated circuits, light is confined in thin film wave guides that are deposited on the surface or buried inside a substrate. Actually in Laser beams can be transmitted through the air, but atmospheric variations cause undesirable changes in the optical characteristics of the path from day to day, and even from instant to instant. Laser beams also can be manipulated for signal processing, but that requires optical components such as prism, lenses, mirrors, electro optic modulators and detectors. In optical integrated sensor using Glasses, dielectric crystals and semiconductors can be used as substrate materials[2]. The functions that can be realized depend on the type of substrate used. Researchers are challenged to identifying materials which have both the right electro-optical properties and a reliable means of forming them into useful structures on the integrated circuit. Unfortunately, many current-generation materials that are used to fabricate monolithic optical devices have high attenuation and therefore high transmission losses.

1.1 Architecture of IOS:

The most fundamental building block of an optical integrated sensor circuits as shown in fig.1 is a channel wave guide. Wave guides in integrated-optics work similar to conventional fibers, trapping light in a length of material. This material is surrounded by material of a different index of refraction[3]. The wave guides are made either by depositing material on top of a substrate and etching unwanted portions away, or etching trenches in the substrate and filling them with polymers, silicates, or other light-transmitting materials.

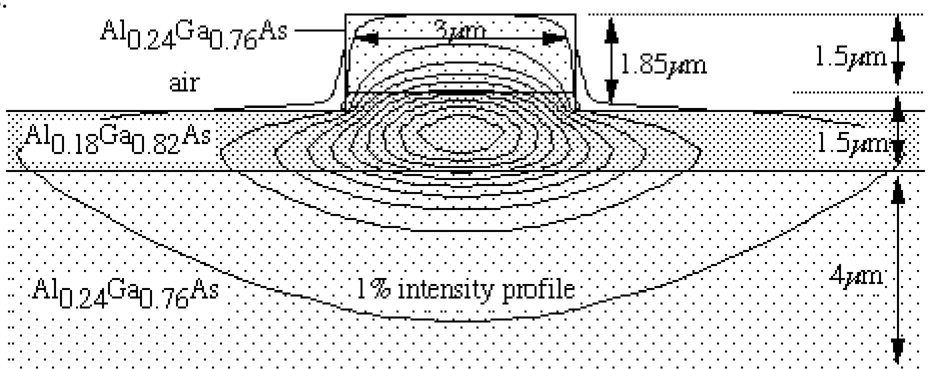

Fig.1. optical integrated sensor circuit

II. Materials and technologies:

2.1.light-on-a-chip devices:

- Filters are used to select desired wavelengths out of a wavelength division multiplexer (WDM) stream, or block a particular channel from being injected into a multiplexer.
- Semiconductor lasers can be made into very effective filters for some applications if they operated below their threshold point. They have sharp and narrow filter characteristics, and can filter a signal as well as produce gain[4].
- On/off switches can be created using many technologies, including Mach-Zehnder-effect devices.

The basic requirements of a thin film optical guide material are that it be transparent to the wavelength of interest and that it have a refractive index higher than that of the medium in which it is embedded.

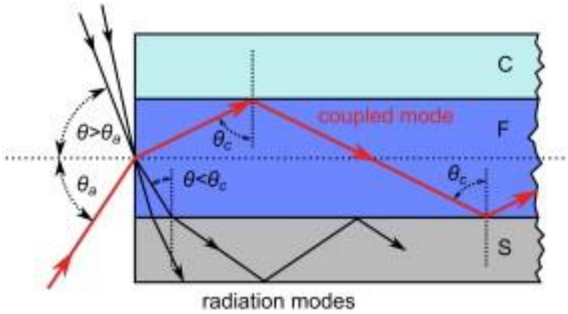

Fig.2. optical guide

Within an optical integrated circuit, light propagates as shown fig.2 as a guided wave in a dielectric thin film. Appropriate addition of functional devices between interconnecting wave guides enables the realization of an optical integrated circuit for a specific use. Some devices can be made on planar substrates using standard lithographic processes and thin-film technologies. Electron beam writing and laser beam writing are increasingly employed to produce patterns with high resolution[5]. Epitaxial methods are used in the fabrication of sources, detectors and opto-electronic circuits on GaAs, Si and InP.

For a square channel wave guide of depth d the number of modes is approximately m2, where m = (2d/λ) NA, m >> 1. For a slab wave guide the number of modes is approximately m. For single mode operation in any channel wave guide we therefore need (2d/λ)*NA ≤ 1, where d is the width of the channel. A single mode wave guide can be constructed by making d and NA sufficiently small. NA is the numerical aperture and for small Δ is given by NA = ncore(2Δ)1/2, where Δ = (ncore - ncladding)/ncore.

III. Wave guide:

A branch in as shown in fig.3 wave guide consists of a single input wave guide, a short tapered section, and two output wave guides[6]. Branches are used to divide a beam into many channels, but the loss at a branch is always significant. Cascading n branches results in a star coupler with 2n outputs.

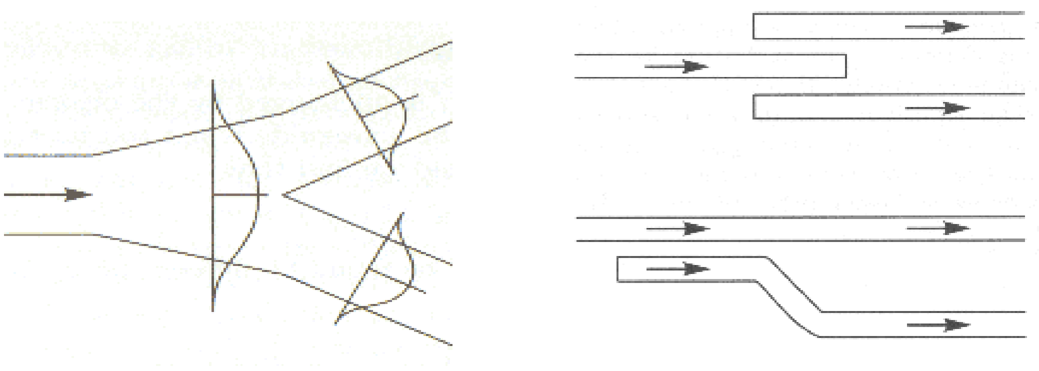

Fig.3 wave guides

Directional couplers can be used as branches with less loss. Many directional couplers work by coupling the evanescent wave into the adjacent wave guide. The wave guides must be spaced approximately a wavelength apart. The wave that is excited in the second wave guide propagates in the same direction as the wave in the first guide. The spacing between the wave guides must be adjusted for the desired power transfer.

IV. Optical Prototyping

Our in-house diamond turning, glass lens fabrication, CNC machining, Wire EDM, injection molding, and assembly and test equipment enables us to build precision prototypes much faster and less expensively than separately sourcing optics and mount parts.

Another type of coupler is based on Bragg reflection[7]. A fiber Bragg grating is made from a section of ordinary single-mode optical fiber, typically a few millimeters to a few centimeters in length[8]. The grating is formed by causing periodic variations in the index of refraction of the glass lengthwise along the fiber.

V. Conclusion:

IOS is Optoelectronics is the study and application of electronic devices and systems that source, detect and control light, usually considered a sub-field of photonics. In this context, light often includes invisible forms of radiation such as gamma rays, X-rays, ultraviolet and infrared, in addition to visible light[9]. Optoelectronic devices are electrical-to-optical or optical-to-electrical transducers, or instruments that use such devices in their operation. Electro-optics is often erroneously used as a synonym, but is a wider branch of physics that concerns all interactions between light and electric fields, whether or not they form part of an electronic device[10]. Optoelectronics is based on the quantum mechanical effects of light on electronic materials, especially semiconductors, sometimes in the presence of electric fields

References:

1. Brenner, K.-H.; Huang, Alan (1986). "Logic and architectures for digital optical computers
2.VESELKA, J. J., BOGERT, G. A.: "Low-insertion-Ioss channel wave guides in LiNb03 fabricated by proton exchange", Electron. Lett., vol. 23, pp. 265-266, 1987
3. OKUDA, E., W ADA, H. and Y MiASAKl, T: "Optical access or and star coupler composed of planar gradient-index glass wave guide". Proc. 100C-ECOC 85, Venice, Italy, pp. 423-426, 1988
4. Brenner, K.-H. (1988). "A programmable optical processor based on symbolic substitution"
5. SEKI, M., SUGAWARA, R., OKUDA, E., HA~ADA, Y. and YAMASAKI, T: "Making a high performance guided-wave multi/demultiplexer by effective design considerations", Proc.
OFC/IOOC 87, Reno, Nevada, paper TUK2, 1989
6. V ALETTE, S., LIZET, J., MOTTIER, P., JADOT, J. P., RE~Alm, S., FOURNIER, A., GROlJ1LLET, A.M., GIDON, P. and DENIS, H.: "Integrated optical spectrum analyzer using planar technology on oxidized silicon substrate", Electron. Lett., vol. 19, pp. 883-885, 1997
7. LIZET, J., GIDON, P., V ALETTE, S.: "Integrated optics displacement sensor achieved on silicon substrate", Proc. ECIO 87, Glasgow, Scotland, pp. 210-212, 1999.
8. Larry Coldren; Scott Corzine; Milan Mashanovitch (2012). Diode Lasers and Photonic Integrated Circuits (Second ed.). John Wiley and Sons.
9. Larry Coldren; Scott Corzine; Milan Mashanovitch (2012). Diode Lasers and Photonic Integrated Circuits (Second ed.). John Wiley and Sons
10.IKEDA, Y., OKUDA, E. and OIKAWA, M.: "Graded-index optical waveguides and planar microlens arrays and their applications".