Session 11

Lectures:

Automatic Assembly of Optical Elements

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Abstract

Automatic alignment and assembly of optical elements is still a challenge in the optical industry, especially for high volume assembly lines. We developed high accuracy alignment, fast curing bonding and sealing processes for bulk optics (mirrors, filters and lenses) that enable us to greatly promote our assembly lines. The alignment processes include 'passive' alignment that is based on the geometrical properties of the elements, and 'active' alignment that is based on the resulting beam properties or optical transmittance of the assembly. The adhesives developed for glass-aluminum bonding having low Young's Modulus (to allow expansion coefficient differences), high dimensional stability and fast UV curing.
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Using Optical Communication Technologies for Next Generation Fiber Optical Gyros

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Abstract

Al Cielo's team developed the world's largest fast Optical-Switch, based on it's Optical Phased Array (OPA) technology. Currently we are providing a line of high performance Fiber Optical Gyros (FOG) to the Israeli industry. The development of the FOG and the transfer to production was relatively quick due to the strong background, experience and facilities of Al Cielo in optical communications. The building blocks of a FOG are: light source, optical fibers and couplers, Integrated Optical Circuit (IOC), detector and electronics, all which are very similar to what is used in optical communication. Al Cielo is using its in-house capabilities and semiconductor FAB to manufacture all of the components as well as integrate and test the FOG. We will present the FOG and its building blocks.

"Collaborative efforts Industry and Academia can yield significant outcome in advanced electro-optics packaging"

Abstract

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The current optical communication market is on the rise with remarkable growth that very few markets can claim. To cope and properly support such growth, there is a need for effective collaboration to increase the combined value and remain competitive.

Today, the cost of the components is a major factor and the single most important element in buying decisions, while the performance is taken for granted. The major contributors to the cost are the packaging and testing; each contributes about half and together accounted for 60-80% of the total cost.

The long term success of the optical component industry is highly dependent on increase performance while reducing the cost continuously to remain competitive over any currently used technologies.

One of the alternatives to successfully address the increased challenge of complexity, fast time to market and low cost, is combining forces of industry expert and leading edge researchers from the academia under the framework of a consortium. The outcome can bring winning advanced solutions within relatively short time and overall lower development cost to the market. The combined know-how gained over wide range of technologies, utilizing expertise and experience from other industries such as semiconductors with its proven manufacturing methodologies and infrastructure can greatly facilitate productive execution.

Managing Academia and industry collaborative and successful efforts is a task by itself that if properly done and executed, will result in significant benefit to the companies, academia and the users and provide a long term platform that is supported by vast range of industry leaders thus making it more pruned for success.

During the talk today I will address the main technological and integration challenges and describe methodology by which collaborated efforts between academia and industry can be effectively managed to create a mutually rewarded outcome under a government funded consortium for Optical packaging known as OptiPac. In addition I will highlight direction for the local industry to grow further and become a key player in the market.

ULTRA-COMPACT OPTICS FOR FLUX TRANSFER NEAR THE THERMODYNAMIC LIMIT FOR INDUSTRIAL APPLICATIONS IN SOLAR CONCENTRATION AND MEDICINE

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Abstract: We report how aplanatic optics can be exploited to provide flux transfer near the thermodynamic limit for industrial applications in high-flux solar power generation (far-field) and light-based surgery (near-field). Our optics are also shown to satisfy the fundamental compactness limit for optical concentrators. Although recognized in telescope design for improved image formation, aplanatic optics had never been explored as maximum flux transfer devices. For sufficiently small light source size (relevant to concentration of sunlight and bright plasma lamps), aplanats can outperform even the best non-imaging designs – of particular interest in applications such as those noted here where image fidelity is irrelevant. We present the design, fabrication and performance of industrial units based on these optical strategies.

Advances in hybrid electro-optical Printed Circuit Boards

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Optical components are capable of providing the solution for high speed communication and are currently searching for their place on-board [i]. Consequently, a current trend of PCB manufacturers is to supply the infrastructure for the hybrid systems including both electrical and optical components. In earlier stage applications with only a few optical components on board, it was possible to use external optical channels to interconnect them; however this solution fails for a growing number of optical ports on-board.

Like electrical components are interconnected by copper traces, optical components may be interconnected by optical traces, such as polymer optical waveguides [ii] and embedded optical fibers [iii]. Similarly to electrical traces, optical traces may require complicated routing architectures with hundreds or thousands of optical lines connecting transmitting and receiving optical components. Achieving such architectures may be quite challenging in optical case, since the optical waveguides can not be sharply bended on the contrary to the electrical guides [iv]. An associated challenge is an optical signal redirection from the board plane to the surface, where the optical elements are mounted [v].

As a member of Israel Optipack consortia, Eltek together with Technion Microphotonic group, have developed a basic infrastructures for optical routing on board. We will present our achievements in the field, including embedded optical fibers, polymeric waveguides on PCB substrates and full surface-to-surface optical link, based on flexible fiber ribbon.

ELECTROOPTICAL DEVICE FOR FOCUSSING BEAMS FROM A GREAT NUMBER OF LEDS

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The optical devices using light-emitting diodes (LEDs) emit scattered light. Such a device making it possible to focus the light emitted by multiple LEDs into a light spot of at most 2 mm in diameter has been developed for the first time.

Main applications of such devices are lighting systems, electric torches, light flux input arrangements for light guides and optical fibers.

The principal difficulty of focussing consisted in the fact that LEDs, unlike laser diodes, have no point source of radiation (emitter).

The developed device is also featured by the possibility of adjusting the size of light spot not by optical but by mechanical means.

SUB-NANOMETER RESOLUTION, FULL CROSS-SECTION CHARACTERIZATION OF 3-D SEMICONDUCTOR STRUCTURES USING POLARIZED REFLECTOMETRY

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The field of semiconductor manufacturing is a unique area where extreme leading edge manufacturing technologies constantly push the envelope of characterization capabilities. The need for nanometer-scale control of geometries requires development of sub-nanometer resolution characterization techniques.

We have developed a system for full cross-section dimensional measurement of complex 3-dimensional structures on semiconductor wafers with sub-nanometer resolution. This system is utilized to provide nanometer-scale control of process parameters during manufacturing. The measurement channel is a wide-band DUV-NIR Polarized Reflectometer with diffraction-limited spot-size throughout the range of 250nm to 900m. The system is calibrated with high accuracy for measurement of absolute reflectivity, enabling real sensitivity to extremely small geometrical changes of the measured structures. Results are calculated based on rigorous electromagnetic analysis of reflected signals, taking into account all absorption, interference and diffraction effects. The system provides real-time results, enabling in-line measurement of parameters otherwise inaccessible except to destructive cross-section based techniques. Examples of actual device structures measured in production will be described. The compact size of the system enables integration directly into process equipment in order to provide capabilities for automated wafer-to-wafer closed-loop-control of the process. The system configuration enables measurement of wafers in air, vacuum or wet environments.

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