Dicing Opto- Electronic Components for the Communication Market

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Introduction

The communication market offers an extremely wide array of Opto-electronic Components. This market is still in its growing stage with many new different start-ups introducing new substrate designs and new dicing challenges.
In recent years, new class integrated and tunable optical components have been developed using VLSI compatible technologies and other mature technologies such as MEMS (Micro Electronic Mechanical Systems).
These technologies are used to produce platforms that are called planer light wave circuits (PLC's). These platforms provide dramatic size reduction of optical circuits and are specially optimized for optical elements such as filters, switches, detectors and lasers.

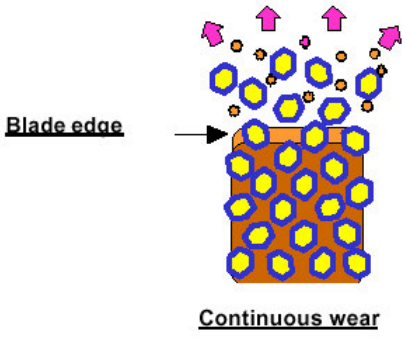
- Main Applications in the market today:
- Wave guides
- Optical connectors & transceivers
- MEMS (Micro Electronic Mechanical Systems)
- DWDM (Dense wavelength division multiplexing) filters
- Optical amplifiers
- Tunable lasers / Laser modules
- Fiber optic couplers
- Optical ICs
- Micro optics

The large variety of products involves a wide range of different materials with different hardness and brittleness characteristics. Some of the materials involved are: Silicon, Silica, GaAs, LiNb0?, Sapphire, Quartz, InP, YVO_4, Silica on Silicon and others. The large material span involves different quality specifications with very demanding requirements involving state of the art dicing solutions. A major significant requirement is the surface finish of some optical component in order to minimize any light insertion loss. Other quality requirements are cut perpendicularity, cut straightness, top- and chipping. In many cases, the dicing quality requirements involve non- homogenous back-side multi- layer materials of silica on silicon and other semiconductor and optical materials.

The non- homogenous combination of materials makes the dicing process much more demanding and challenging. In addition to the quality requirements, some of the substrates are very complex with extremely accurate requirements regarding automatic vision alignment and indexing on the dicing saw.
ADT has worked in last few years very closely with several key optical /communications houses including many start- ups from the initial R& D stages. Some unique features were developed on the ADT saws to meet the very demanding market requirements. In addition, special blade matrices and unique dicing process parameters where developed parallel to the development of advanced versions of the 7100 saw. The combination of these unique ADT developments leaded to the presentation of a total solution for these demanding process requirements.

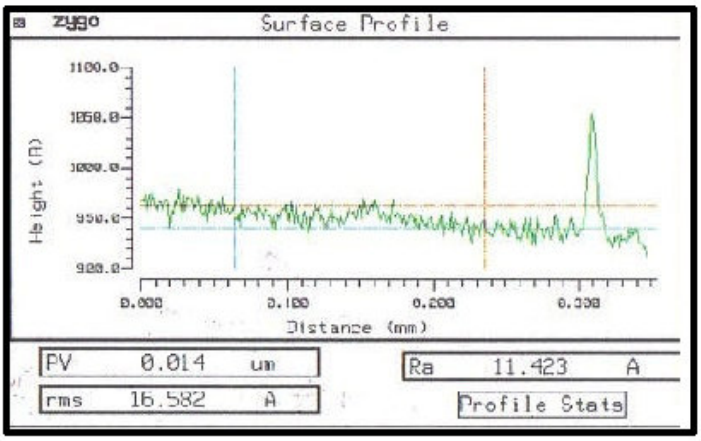
The Dicing process

The most common materials used in the communication market are silica, silicon and combinations of both. On some substrates, we also face special coatings like AR (anti reflection). These coatings are hard and brittle and add more challenges to the dicing process. The main challenge in most cases is the surface finish required on surfaces designed to transmit light. The requirements for surface finish can be in the range of A Ra and even better. The traditional method is to dice and then lap and polish the 80-100 diced surface. The lapping / polishing process requires many steps, significant handling and polishing time. Achieving the required surface finish or close to the required surface finish can save a lot of handling and polishing time and in some cases even eliminate the need for polishing. The most common blade matrix to meet the surface finish requirements is phenolice resin. ADT has developed special blade matrices to meet the demanding quality requirements. The principle is to create a super free cutting action and to minimize temperatures and loads. The ADT special resin blade matrices consist of very fine diamond grits and diamond types. Both the diamond type and diamond concentration are specially optimized to meet the customer's requirements. The idea is to minimize the surface damage of both the kerf walls and the kerf edge . Usually, smaller diamonds create higher loads, however, the special ADT resin blades are designed to minimize this effect by releasing dull diamonds, exposing new sharp diamonds in such a way that temperatures are minimized and a free cutting action is achieved (see the sketch).



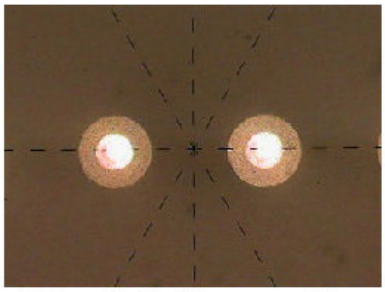
In addition to special blade designs, ADT developed other process parameters that proved to be a major factor for the cut quality required. Lowering the surface tension of the coolant by adding coolant additives contributed to achieve the quality goal, mainly the surface finish. Dynamically balancing the flange and blade assembly to 0.02mm/ sec. was found to be necessary in some applications and was a tremendous improvement and a key factor to improve the kerf sur face finish of wave guide type substrates. The dynamical balancing is done on the saw by measuring the vibrations and adding weights to the flange assembly.

Bellow is a surface finish diagram of a typical borosilicate substrate diced with a special ADT resinoid blade. This blade has a fine diamond grit with an optimized diamond concentration. The flange set was dynamically balanced and a coolant additive was used.
The results measured on a Zygo surface finish analyzer system were of extremely high quality with an Ra of 11.4A.

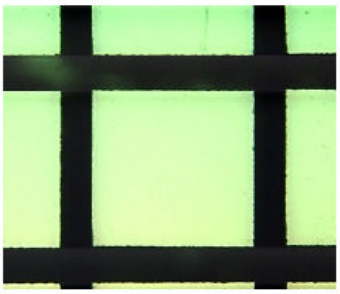


Typical Zygo surface finish diagram

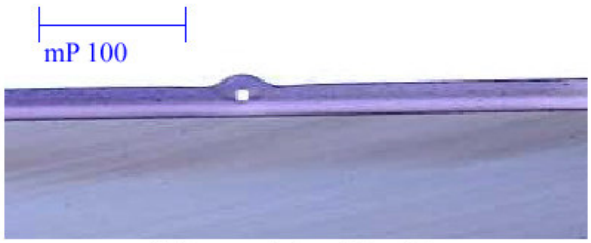
Following are a few micrographs of typical communication applications diced on the ADT 7100 dicing system using the ADT special designed resinoid blades and specially optimized dicing process parameters:



Fiber Optic Cross section
diced at 5mm / sec



Borosilicate substrate
diced at 1mm / sec

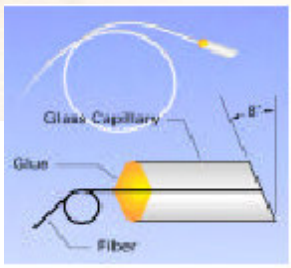


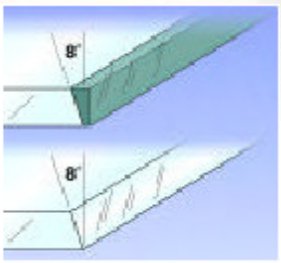
Wave guide with AR
coating diced
at 1mm / sec

7100 TS (Tilted Spindle) special saw features

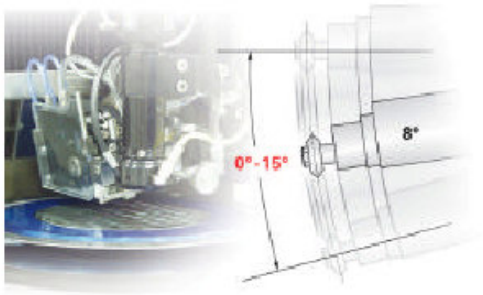
ADT developed a superb dicing system for the communications market.
A major feature on this system is a tilted spindle to meet the needs of optoelectronic components manufactured by providing both perpendicular cuts and 8º angular cuts needed to suppress back reflection in fiber optic components. Dicing an angular 8º with a tilted spindle eliminates the need for an extra expensive grinding and polishing process.

See the bellow sketch:





The ADT 7100TS has a quick spindle changeover from perpendicular (0º) to any angle up to 15º with a field fine adjustment capability, 0.1º angular repeatability and 0.1º angular resolution.



The 7100TS can be used for the following angular applications:

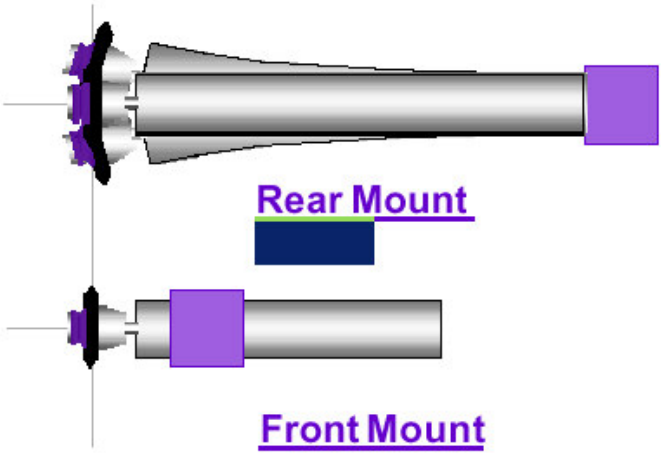
- Planer Wave Guides
- Si., Silica- on Si
- Polymers on Si
- InP
- GaAs

Front mounted spindle

The ADT 7100 model has a front mounted spindle design for superior accuracy. In many communication processes this design was proved to eliminate the need for polishing, while providing optical surface finishes.

The main advantages of this design are:

- Reduced vibration / better cut quality
- Increased rigidity.
- Improved accuracy



ADT is committed to new market demands of new challenging applications.
ADT will work together with any customer to develop a total solution for their new or future demands. This will include blade and process optimization and recommending the best saw configuration.