Laser cutting of Display glass

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Advances in the FPD production require advances in processing technologies.
Therefore new laser glass cutting technologies were developed to an industry proof stage. The implementation in an existing or extending production line enables the usage of the advantages like micro crack free cutting, no splinters, increase of yield, etc…

In recent years JENOPTIK Automatisierungstechnik GmbH has developed into a leading manufacturer of systems for laser material processing on non-metal materials, with first-class international references.
Various technologies for the use of lasers for non-metals have been applied with the product family of JENOPTIK-VOTAN ™ to units ready for series production and successfully marketed.

The estimated huge growing of FPD sales expected form further drop of the end- user prices. Therefore a reduction of production costs is necessary too. One way to reducing costs is to use larger mother glasses. Further way is to increase the yield of the production. New processing technologies and flexibility are required.

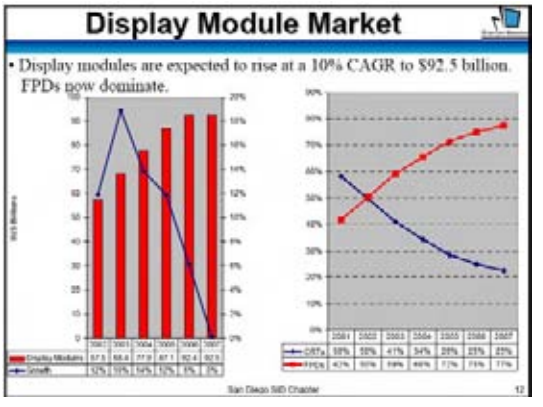

Figure 1: Display Module Market

Innovative JENOPTIK-VOTAN™ G systems permit the processing of all kind of glass with laser and helps to save costs.

The traditional methods of separating glass uses a diamond wheel for mechanical scoring, followed by a snap-off operation. The disadvantages of scoring are chipping effects and micro-cracks along the break-edge. This may even lead to macro-cracks. For this reason, every edge needs additional grinding which translates into extra work efforts and extra footprint requirements. Besides due to further reducing of the glass thickness the mechanically scoring comes to the physical limitations.
By means of JENOPTIK laser technology these disadvantages can be avoided. Due to the micro-crack- and ablation free cutting result the edge strength of the material is increased by up to 50% and further processing steps like grinding and washing could partial be saved.

The JENOPTIK-VOTAN™ G laser processing machine with its specifically adapted thermal laser beam separation (TLS) process scores the glass by motion along the longitudinal axis to exceed the quality of previous cutting technologies. This is accomplished with a laser beam performing localized heating of the surface material which is subsequently cooled. Local tension appear near the surface and induce a crack in the material. Starting from the initial crack, a crack propagates along the working line. Finally, the glass stripe is separated from the substrate which moves on for further processing.

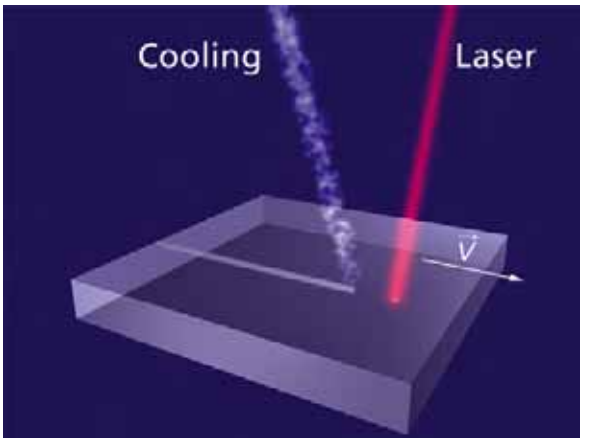

Figure 2: TLS Cutting Process

Furthermore an upgrade of the TLS technology is the TLS advanced method. Basically it is the same as the TLS method but additionally a second laser beam pushes the superficial crack vertically through the body of the material.

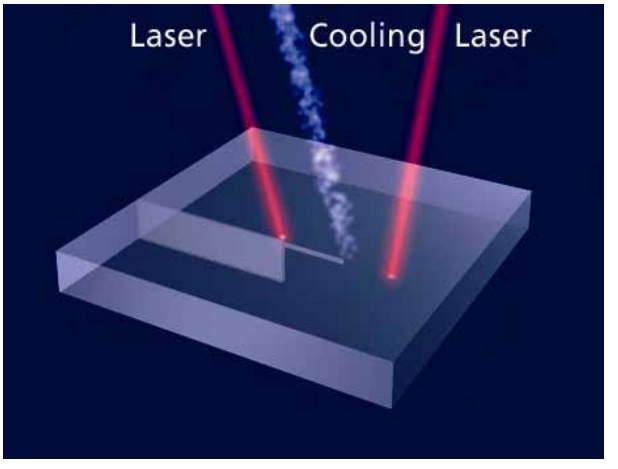

Figure 3: TLS Advanced Cutting Process

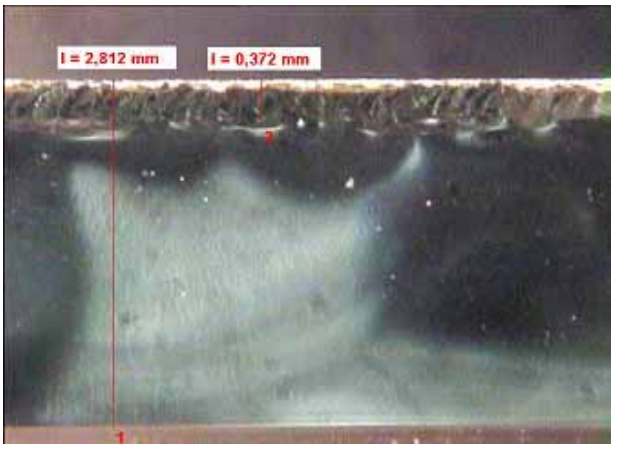

Figure 4: Mechanically Scored Glass With Micro Cracks

Figure 5: Laser Cut Of Glass Is Free Of Micro Cracks

In comparison of scoring and laser cutting there are chipping effects and micro-cracks along the break-edge at the scoring (Figure 4)

By contrast a clearly smooth edge is demonstrated after the laser process (Figure 5)

Furthermore the unevenness of the processed glasses are demonstrated.

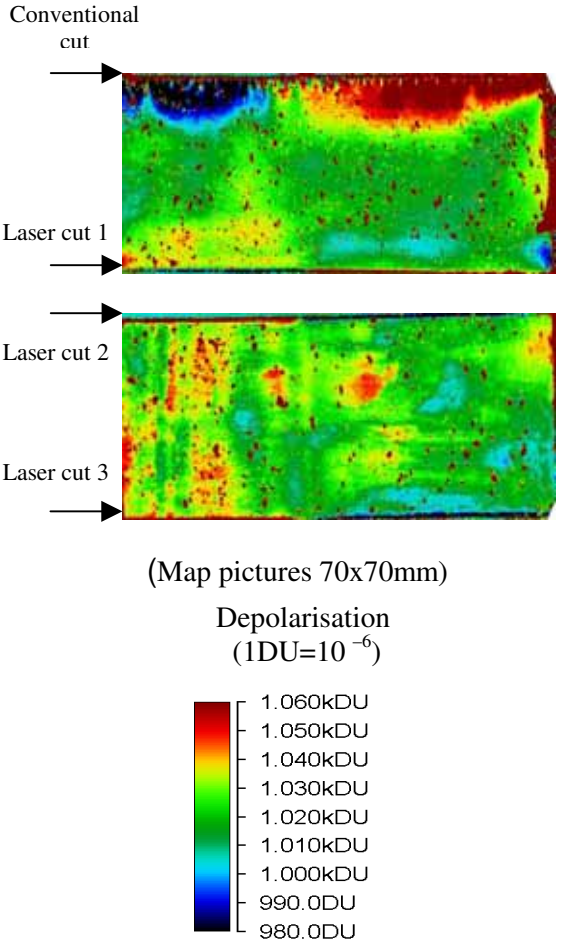

Figure 6: Stress Analysis

Figure 6 illustrates the introduced stress into two separated glass substrates. Inside of the red and dark blue areas the stress is most significant. The complete laser separated substrate shows no stress and no micro cracks. This guarantees greater flexural strength and stability.

Due to all presented advantages of the laser process conventional cutting technology is obsolete.

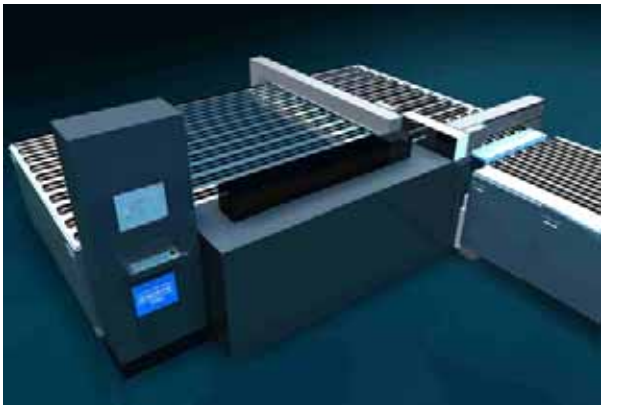

Figure 7: JENOPTIK VOTAN™ G Flow

At the end the high versatility is adapted to the different JENOPTIK laser technologies for the different customer needs. On the one hand the scribe and break method and on the other hand the full separation of glass is possible.

Systems for cutting LCD displays which are already assembled into a complete display cell (double layer) as well as single glass are available.

Due to the high degree of automation these JENOPTIK laser technologies can be easily integrated into production lines or stand alone solutions are possible.

Benefits of JENOPTIK laser technology

- cutting of extremely thin glass possible
- scribe/ break and full separation possible
- high processing speed up to 400mm/s
- inline and stand alone systems up to GEN 8 available
- superior cutting quality, perfect ablation free, no glass splinter, no glass dust on the glass surface
- no micro cracks in the cutting edge
- higher flexural strength (up to 2 times than mechanically scored)
- no chipping
- no cutting oil required
- no washing and grinding processes necessary
- contact less process with a no-wear tool (laser beam)
- traceable process due to electronically controlled parameters
- increase of yield

References

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[4] AU Optronics Corp., H.B.Chen, 2005

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