Dicing: Laser MicroJet® Is the Name of the Game!

With today's rapidly evolving world demanding more and more miniaturization, innovative technologies are constantly in demand to satisfy the needs of the micromachining industry. The requirements placed by these industries are for high precision, quality and yield, as well as minimized ownership and production costs.

One industry where these requirements are especially true is in semiconductor manufacturing, for the dicing of silicon, Ge or compound wafer, where the die yield from each wafer is of paramount importance. It was into this high-tech scenario that the inventors of the unique concept for a water jet-guided laser-cutting device put into practice their ideas, with a machine especially configured to carry out this very delicate operation. The concept known as the Laser Microjet®, patented by Synova S.A. for over 10 years now, has established itself as the solution to most of the problems, such as cracking, chipping, HAZ, contamination or deposition, experienced with today's other existing technologies. It is now an established process with field-proven applications worldwide capable of processing wafers up to 300 mm. Due to the minimal stress that the target material experiences during Laser Microjet® dicing, it exhibits a much higher fracture strength than materials subjected to other existing methods of dicing.

This cutting-edge technology uses the beam from commercially available, robust and reliable laser types, with power ratings up to 200 W and wavelengths ranging from 1064nm down to 355nm. The laser beam is focused into and then guided through the center of a hair-thin jet of low-pressure water by means of total internal reflection.

The nozzle diameter can be selected from 25 µm up to 100 µm, depending on requirements. The resulting cutting beam is therefore effectively focus-free, produces a corresponding narrow kerf width and can achieve large cutting depths of up to 1,000 times the nozzle diameter. The water jet simultaneously provides sufficient material cooling between laser pulses to avoid heat damage to the work piece material and flushes ablated material from the kerf. The thin film of water, which forms on the top surface of the wafer, prevents any deposition of ablated material, negating the requirement for any protective coating. The forces from the low-pressure water jet on the work piece are negligible and pose no danger. Figure 1 shows a typical laser dicing system, which is in series production and available in two sizes, either for 8- or 12-inch wafers. Figure 2 shows a close-up view of the heart of the Laser MicroJet® – the cutting head.

Initially Synova supplied a proprietary LaserTape® for use with their machines. However, extensive in-house studies carried out with widely available commercial dicing tapes have shown that suitable standard tape from selected suppliers can also be used, thus reducing the production requirements and costs for the machine users.

These innovative studies carried out by Synova and the follow-on experiences of international users of the Laser Microjet® equipment have shown that the use of standard dicing tape, such as Lintec 611 or 628, when combined with the superior Synova technology, results in finished products that cannot be equaled. The recommended dicing tapes provide sufficient adhesive force to prevent chip-fly during cutting and avoid debris-contaminated water from penetrating under the wafer.

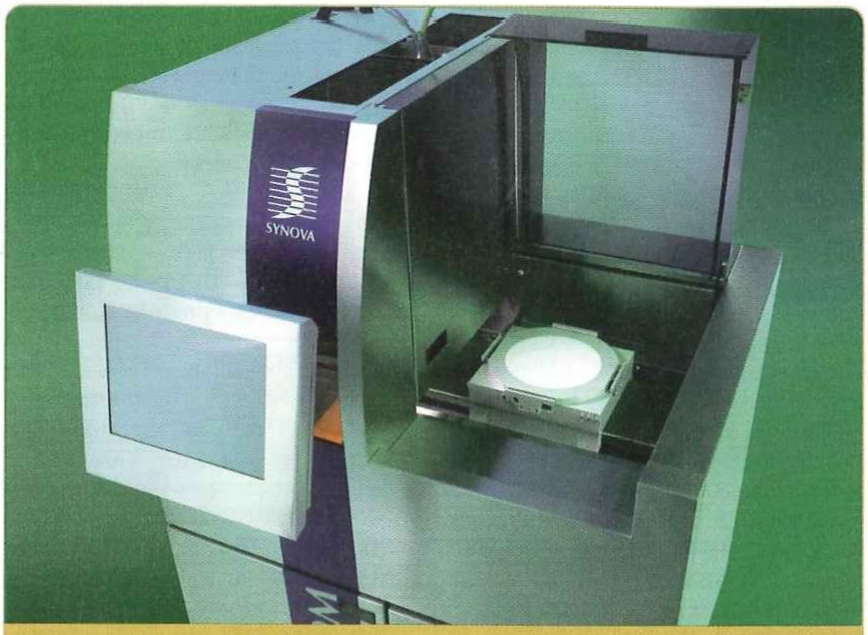

Figure 1. Laser Dicing System Powered by Laser MicroJet®

This, if it occurred, could result in wafer cracking or breakage due to water pressure buildup under the die, especially with very thin wafers.

Using the Laser Microjet® technology, under real-time software control, modifying programmable parameters such as the laser power, frequency, pulse width and speed of movement of the head, the depth of cut can be precisely set, so that at the final point of singulation the underlying tape is not heated or possibly burnt. In practice, the water provides sufficient cooling so that there is little risk of damage occurring. This, however, has strong implications for the later safe handling of wafers when, after curing of the adhesive on the tape with UV irradiation, the tape is stretched to increase separation between the dies, to allow easy removal of the chips for later pick-and-place operations.

There are many further important manufacturing advantages to be gained from using the Laser Microjet® technology. The faster cutting speeds that can be achieved, presently up to 300 mm/s depending on wafer thickness, with speeds of up to 1,000 mm/s under development. The precise variable depth of cut, combined with the very fine kerfs possible, potentially <15 µm may soon be feasible, and the perfectly parallel kerf walls produced.

Further benefits that can be gained from the use of this technology are the ability to cut nearly any desired shape, such as hexagonal shapes in 350 µm silicon with metallized top layer, a task that no other technology is capable of performing. Additional applications for Laser Microjet® technology in combination with present-day diamond saw processing are also now being exploited for dicing applications of complex layered materials.

Synova provides turnkey, fully automated laser cutting systems to their core markets, the semiconductor, electronics (i.e., flat-panel displays and MEMS), photovoltaic, tooling, medical and automotive industries, as well as to peripheral markets, including the tooling, watch and micro-mechanics industries. In addition, Synova offers Laser MicroJet® modules for end-user integration, and has recently made its core Laser MicroJet® technology available to select equipment manufacturers through licensing partnerships.

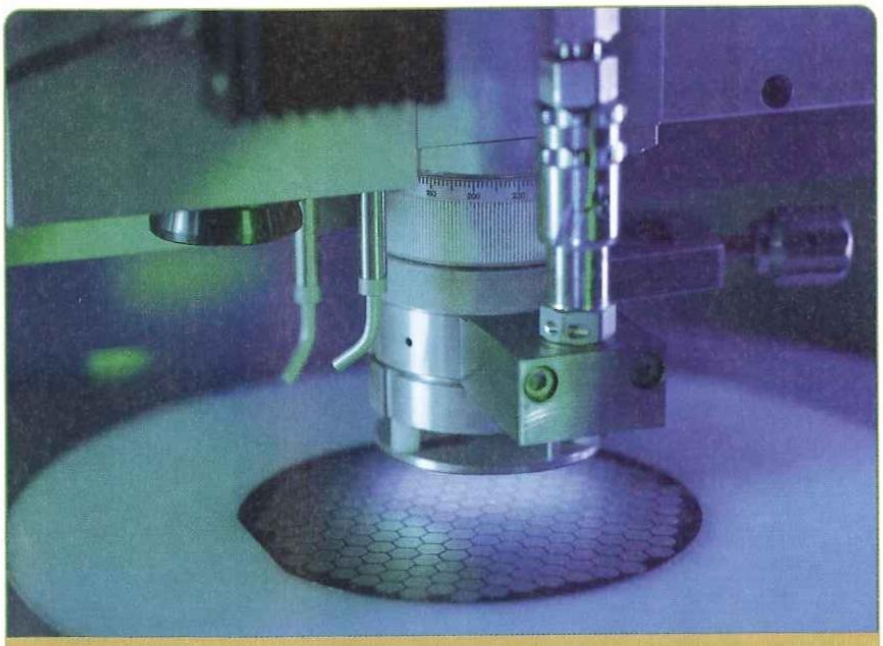

Figure 2. The Heart of the Laser MicroJet® – the Cutting Head

SYNOVA

Synova – through its proprietary Laser MicroJet® technology – is a leading supplier of state-of-the-art laser solutions for a wide range of industries.

Bernold Richerzhagen
CEO

Philippe Senn
COO

Quoc Phong Dang
CFO

Frank Meier
Vice President Operations

Synova SA
Chemin de la Dent d'Oche
1024 Ecublens
Switzerland
Phone +41 21 694 35 00
Fax +41 21 694 35 01
info@synova.ch
www.synova.ch

Business Contact
Roy Housh
Director of Sales, Europe & Middle East
housh@synova.ch

Frédéric Pasche
Sales Manager Asia Pacific
pasche@synova.ch

Notker Kling
USA General Manager
kling@synova-usa.com