Laser cutting thin wafers — breaking new ground with a new technique

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Engineers at Austrian chip manufacturer Infineon were experiencing severe problems when it came to processing thin wafers. Then they discovered a system combining a laser source and a water jet.

Many of today's chip manufacturers face major challenges when it comes to processing thin wafers (those with a thickness of less than 100µm). The main problem with thin wafers lies in the fragility of the edge due to the thinning of the wafer, which renders the edge very brittle. In fact, during processing, even the smallest damage at the edge can lead to wafer breakage, and, consequently, to total material loss during handling in subsequent processes. As a result, it is paramount for chip manufacturers to find a method for detecting edge damage in order to avoid wafer losses.

With this in mind, the Laser Microjet® developed by Synova SA has become increasingly popular in the semiconductor industry over the past six months. Its primary application is the efficient chipping-free dicing of silicon wafers, but it is also very useful for less common operations. One of the most promising was developed and implemented for Infineon, the well-known European chip manufacturer.

Engineers from Infineon spent a huge amount of time to find a solution to the problems associated with thin wafer processing. Their requirements, due to the specificity of the material, were clear: the process should be completely automatic and apply neither thermal nor mechanical constraints on the thin wafer so as not to induce any stress, which could lead to material destruction.

The LDS200 laser dicing system.

In fact, the cause of the breakage problem is due to micro-cracks that form all around the wafer border. So why not just remove them? Since no optical system is yet able to detect the cracks, why not cut entirely around the wafer? The idea stuck and the engineers decided to use Synova's Microjet to grind the brittle edges off the thin wafers.

Indeed, the laser dicing system, combining a laser source and a water jet, had already proven its efficiency on thin wafers regarding precision and quality. The efficiency of the system revealed itself to be just as high in grinding edges as in cutting chips. After several tests by Infineon, the LDS200 machine from Synova was selected to process the edge of thin wafers with diameters of up to 8in.

Improved throughput, lower running costs

This system has many indisputable advantages. First, the water jet absorbs the heat of the laser source, carrying away the molten silicon, so that there is no thermal stress or particle adherence (burrs). Since the entire process is automated, and the cutting is realised by laser, the wafer is not subjected to mechanical stress during the whole process. Furthermore, the precision of the machine allows the diameter to be reduced by very small increments (typically 50µm), minimising the loss in precious material. The machines can also be used for dicing thin wafers. It is while cutting the thinnest wafers that the highest speed can be achieved, thus improving the throughput rate, which results in diminishing running costs.

Infineon supply chains for thin wafers will therefore soon be equipped with LDS200 machines. In a second step, these machines will be upgraded with an integrated edge damage detector, allowing the repair of wafer edges strictly at locations with visible cracks. The optical system already permits the recognition of faults as small as 50µm. ■

Author

Laetitia Mayor is the communication manager at Synova SA in Switzerland. After the development of the Microjet® system in the mid-1990s, Synova was the first company to successfully introduce laser technology for wafer dicing in 2001.