Quality and throughput improvement of GaN/SiC wafer saw with the addition of ultrasonic power

Fraser Wang, Vincent Hsu, Stanley Hsieh, I-Te Cho, Walter Wohlmuth

WIN Semiconductors Corp, No. 35, Technology 7th Road, Hwaya Technology Park,
Kuei Shan Hsiang, Tao Yuan Shien, Taiwan 333

E-mail: forrest@winfoundry.com
Phone: +886-3-3975999#1631

Abstract

GaN/SiC wafers have extremely high hardness and there is a need to improve the mechanical sawing process with the diamond saw blades, to achieve controlled dicing quality and high productivity. Diamond blades are easily broken during sawing and an extra dressing process is necessary to reduce blade meandering and to maintain blade sharpness. Despite the use of a formulated dressing process, the dicing street profiles are often shifted which later introduces increasing chipping area. These problems have been identified as a result from using extremely concentrated loading applied on the blades during the dicing process. In order to meet automatic manufacturing requirements and to reduce the running cost from blade usage and well as labor time, the addition of ultrasonic power to the saw blade is evaluated to reduce the heavy and surged loads on the dicing blades.

To meet high volume production requirements, an ultrasonic unit from DISCO Corporation is adopted successfully to current foundry tools without acquiring extra clean-room space. With optimized blade design, ultrasonic power can be delivered to dicing blades as shown in Fig.1 to provide additional cutting force to efficiently form saw streets in the wafers.

The software controlled programmed power generated from the

ultrasonic unit regulates loading on blades which simultaneously adjusts the cutting forces during process. Figure 2 shows that similar driving current to the spindle is maintain along the entire dicing distance. The meandering dicing issue along a street line is also eliminated with the ultrasonic tool refinement with no significant shift found after cross-wafer sawing as shown in Figure 3.

The variation of backside chipping along a street line is shown in Figure 4. The ultrasonic-aided process shows a reduction in chipping area. The comparison of chipping area and dicing kerf width with ultrasonic-assisted power is shown in Table 1.

Figure 5 illustrates smaller front-side and back-side chipping areas hence total wafer yield is also significantly improved. Ultrasonic-assisted dicing further improves yield loss and reduces the occurrence of scratches caused by blade breakage. Blade lifetime is impressively extended due to longer dicing distance per blade also as shown in Fig. 6.

The improved dicing control afforded by ultrasonic-aided dicing enables the total process time per wafer to be dramatically reduced because no additional dressing during cutting is required and higher dicing speed is achievable while maintaining acceptable front- and back-side chipping. A comparison of the dicing parameters with and without ultrasonic-aided dicing is shown in Table 2.

Although the vibration during the dicing process is larger than the original tool due to the addition of the ultrasonic power, die flying off of the tape issue during the dicing process is not found with the same dicing tapes as shown in Fig 7.

The novel technique to integrate ultrasonic power to the sawing process is proven to be beneficial for mass production of GaN/SiC wafers with lower running cost and extended blade lifetime while maintaining an acceptable degree of chipping and dicing width.

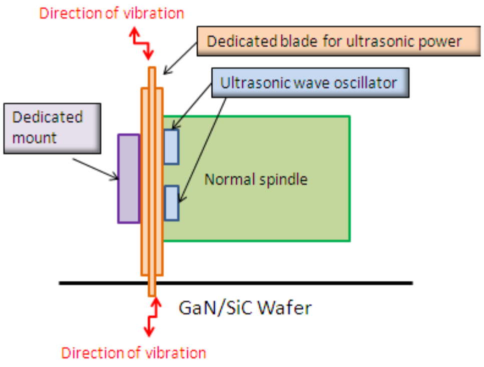

Fig.1 Diagram of ultrasonic power unit

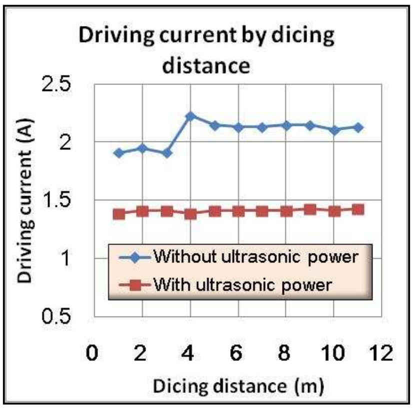

Fig.2 Driving current comparison with ultrasonic-assisted dicing

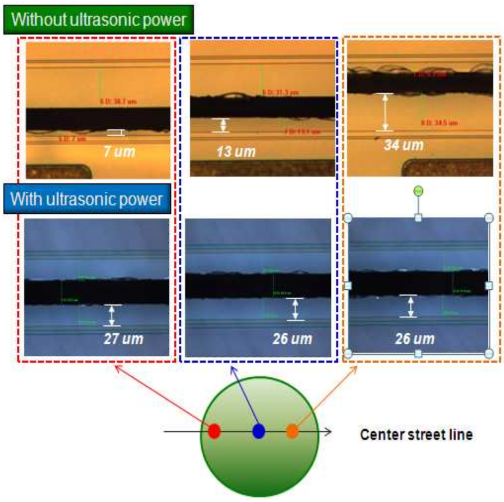

Fig.3 Meandering dicing issue with and without ultrasonic-assisted dicing

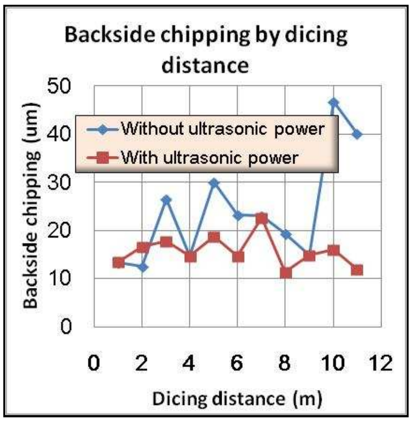

Fig.4 Backside chipping comparison with and without ultrasonic-assisted dicing

Process	Without ultrasonic power	With ultra-sonic power
Front-side chipping	6 ~ 13 um	6 ~ 13 um
Back-side chipping	10 ~50 um	10 ~ 30 um
Kerf width	18~22 um	26~29 um

Table 1 Chipping and kerf width comparison with and without ultrasonic-assisted dicing

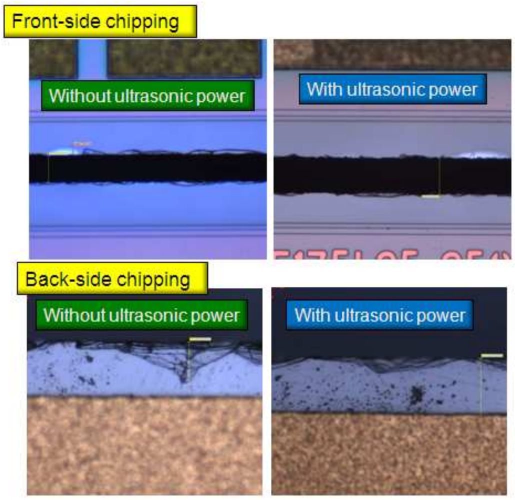

Fig.5 Front-side and back-side chipping comparison with and without ultrasonic-assisted dicing

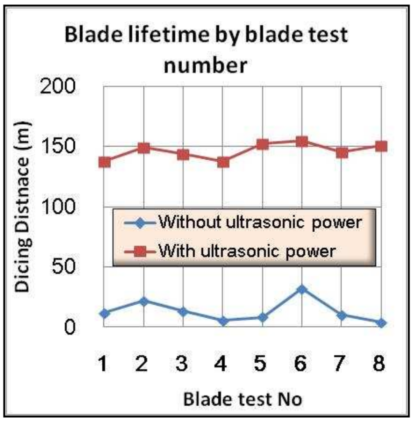

Fig.6 Blade lifetime comparison with and without ultrasonic-assisted dicing

Process	Without ultrasonic power	With ultra-sonic power
Pre dressing	300 sec	300 sec
Cutting (speed)	20240 sec (1 mm/sec)	5060 sec (4mm/sec)
Extra Dressing during cutting	3000 sec (10 times)	Not necessary
Total process time	23540 sec	5360 sec

Table 2 Process time with and without ultrasonic-assisted dicing

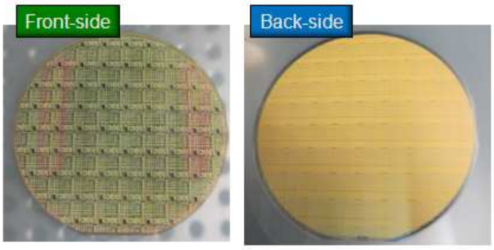

Fig.7 No fly die issue is found by ultrasonic-assisted dicing