Technical-Report

SAMCO NOW

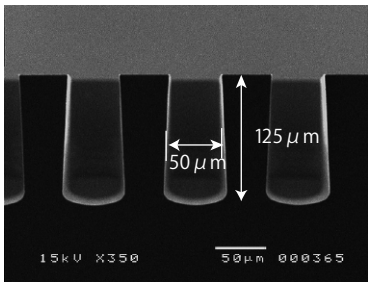
Deep Etching of Compound Semiconductors

In the fields of optoelectronics and power electronics, the need for compound semiconductors is increasing. SAMCO is working specifically on compound semiconductors, and has been developing systems since its establishment in 1979. In the article below, SAMCO provides an introduction to deep etch technology for compound semiconductors. SAMCO anticipates applying this technique to plasma dicing.

The GaAs High-Speed Process

SAMCO developed the GaAs (Gallium Arsenide) high-speed etching process, based on our extensive research experience. The SAMCO RIE-200iP System with the ICP Tornado Coil® was selected for this process. We have had extensive experience with GaAs etching of 200 to 500 nm/min, but our current challenge is to develop high-speed etching rates of 10 μm/min or greater.

High-Speed Deep Etching



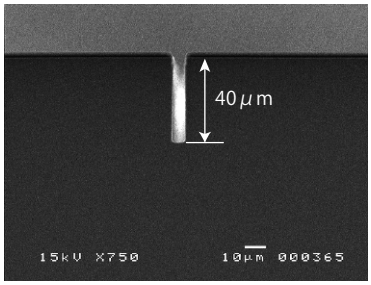
Etch Rate = 12.5 μm/min
Width = 50 μm
Depth = 125 μm
Mask = SiO_2
Selectivity = 800
Substrate = GaAs

The 10-minute process whose results are illustrated here etched to a depth of 125 μm. The etch rate was 12.5 μm/min, and the selectivity was more than 800. This newly developed process achieved vertical, smooth side walls at high-speed etch rates, whereas the old recipe for high-speed etching would result in tapered, rough side walls. Moreover, the new process produced less contamination in the reaction chamber and enabled longer maintenance cycles than did the older method. For these reasons, the new process (or method) is deemed a major improvement over the old one.

This new technology can be applied to processes such as plasma dicing for LEDs, optical MEMS, and via hole.

High Density Plasma Etching System
Model:RIE-200iP

Plasma Dicing



Etch Rate = 4.0 μm/min
Width = 5 μm
Depth = 40 μm
Mask = Photo Resist
Selectivity = 27.6
Substrate = 6" GaAs

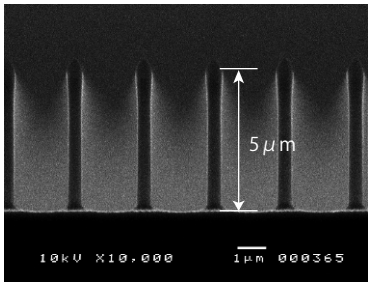
We assumed that a 5 μm wide, 40 μm deep trench would be needed for plasma dicing. The etch rate is 4.0 μm/min and the selectivity is 27.6.

The benefits of plasma dicing over blade cutting are:

1. Multiple fine lines can be processed all at once.
2. All processes can be done by using the dry process method.
3. There is no mechanical/physical damage.
4. Various patterns, such as circles, are available.
5. Throughput can be increased when chip size is smaller.
6. The number of chips produced from 1 substrate can be increased.

Overall, dry process dicing can improve cycle time, throughput, and yield, and is suitable for LED chip dicing.

High-Speed Fine Process



Etch Rate = 1.7 μm/min
L/S = 0.620/2.0 μm
Depth = 5 μm
Mask = Photo Resist
Selectivity = 16.6
Substrate = 3" GaAs

We achieved 620nm wide by 5 μm high pillars at an etch rate of 1.7 μm/min, with 1 μm thick photo resist. The selectivity was 16.6 in this process. The reaction chamber didn't become contaminated and the process allowed good repeatability with smooth, vertical shapes.