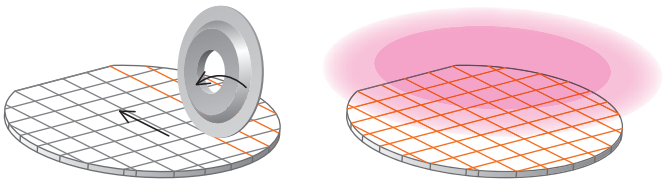
Plasma Dicing Solutions of a Variety of Materials:

From Silicon Wafers with Metal or Resin Layers, to Compound Semiconductors

Blade dicing is widely used in the dicing processes, but its impact and stress cause cracking and chipping of chips. Also, as the chip size becomes smaller, the throuput declines due to the increase in the number of cut lines. Samco proposes plasma dicing solutions by using the Bosch process, with the production-type Deep Reactive Ion Etching (DRIE) system, the RIE-800iPBC. Its plasma dicing technology enables reliable dicing processes, regardless of wafer and chip sizes. Additionally, the technology could be applied to a wide variety of dicing applications such as circular chips, silicon wafers with metal or resin layers, and compound semiconductors.

■ Advantages of Plasma Dicing

Plasma dicing is the dry etching process that uses fluorine chemistry, and does not have physical contact with the chips, unlike blade dicing, which entails physical contact with the chips, resulting in chipping and cracking. Also, with plasma dicing, its dicing process time does not increase when the chip size gets smaller; consequently the number of cut lines increases. On the other hand, blade dicing needs more process time to go through more cut lilnes (Fig. 1). Therefore, plasma dicing is suitable for dicing special shaped chips, such as circular chips, and micro-size chips of 500 µm square or smaller.



Blade Dicing　　Plasma Dicing

Fig.1 The Concept Images of Blade Dicing and Plasma Dicing
- All of the cut lines in the whole wafer are processed simultaneously in plasma dicing.

However, the drawback of plasma dicing is that it requires not only a DRIE system but also other systems for resist coating, exposure and development; therefore, the total number of processes should be increased.

■ Samco's Plasma Dicing Technology

The RIE-800iPBC is a production-type DRIE system specially designed for the Bosch process. This system is capable of high-speed etching (over 40µm/min) and high aspect silicon etching ratio, and it provides process solutions optimized for narrow-patterned and vertical trench fabrication. The etch rate depends on the open area and the aspect ratio (Fig. 2 and Fig. 3). For example, when the scribe open area of a ø8-inch wafer (150µm thick) is 30% and the scribe width is 30 nm, the etching rate is about 16 µm/min, and the whole wafer is diced in ten minutes. Samco provides total plasma dicing solutions including optimization of the process before and after dicing, and is researching dicing technologies including glue for wafer support.

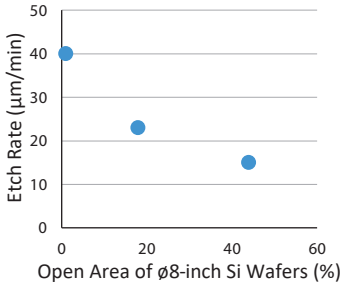


Fig. 2 Open Area of ø8-inch Si Wafers vs. Etch Rate

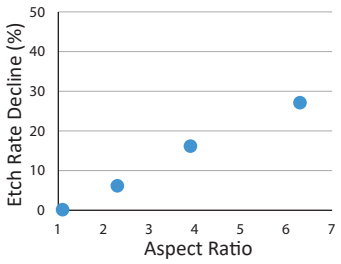


Fig. 3 Aspect Ratio vs. Etch Rate Decline

■ Plasma Dicing Solutions of a Variety of Materials

Samco's research focus on plasma dicing includes dicing of silicon wafers with metal or resin layers, and also continuous etching of gallium nitride and silicon of the gallium nitride on silicon (GaN on Si) wafers by means of fluorine-based plasma.
In the case of blade dicing, silicon wafers with metal layers cause blade clogging. On the other hand, plasma dicing is a non-contact process; therefore, clogging does not occur. In the case of plasma dicing of multiple materials with one system, chamber cleaning and parts exchange will be required. In such a case, installation of several systems dedicated to the etching of each material could save on the total cost. Samco offers plasma dicing technology of various materials, such as GaAs in chlorine-based plasma (please refer our Technical Report Vol. 79), and can provide plasma dicing solutions of a variety of materials, which meet various customer needs.

■ Summary

Samco provides customized plasma dicing solutions to meet each customer's requirements, and will continue to develop plasma dicing technology for a variety of materias used in device manufacturing.