Micro Via Drilling Technology

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Introduction

Currently, PWB industry is striving for the cost down at the daily PWB manufacturing, and at the same time, they are developing the higher density PWB for the future application.

The emerging 300 kmin-1 spindle will shift the overlapping point from mechanical drilling to Laser drilling for the Through Hole (T/H) of PWB core material smaller than 100 µm diameter.

The micro via drilling for glass reinforced core material smaller than 75 µm dia. by CO2 Laser machine, and 20 µm dia. by UV laser for future application are under study. Now I would like to share the stage of development for mechanical and Laser drilling technology.

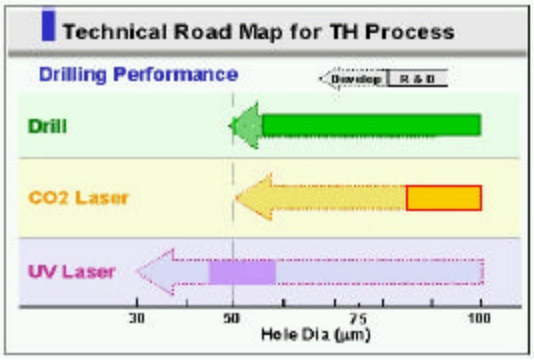

Figure 1 - Recent Technology Improvement for Micro Via (does not reference this figure)

Mechanical Drilling

Micro via T/H drilling by 300min-1 spindle

The micro via T/H under 100µm dia. of the build-up core material is now becoming feasible by mechanical drilling at mass production, because of 300kmin-1 spindle emerged in 2003.

Compared to Laser drilling, the hole quality of mechanical drilling is far better (Figure 2). However, it is essential to reduce the production cost; which means it is required to extend the drill bit life.

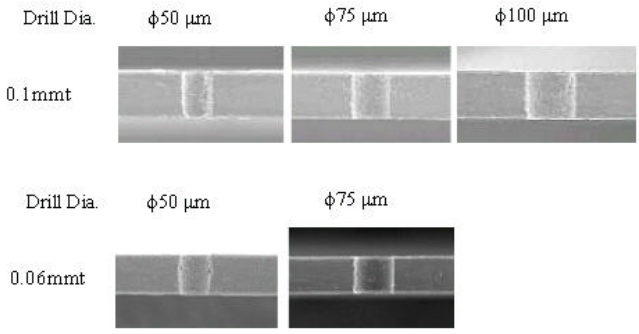

Figure 2 - Typical Hole Quality for Mechanical Drilling

Productivity of Mechanical Drilling

The objective of the drilling under 100 µm dia. at production is to extend of the drill bit life. The life of the drill bit is judged by Burr, Hole Roughness (Fig.3) and Drilled Hole Accuracy.

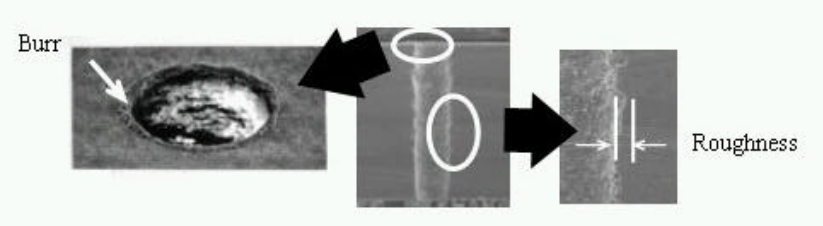

Figure 3 - Hole Quality for Mechanical Drilling

In order to keep the hole quality, it is needed to minimize the drill bit wearing and realize the stable drilling. Drill bit wearing is greatly depends on the Cutting Speed at the drilling, and generally speaking, it requires 50-200 m/min. (Figure 4).

By utilizing 300kmin-1 spindle, the appropriate Cutting Speed is obtained at the 100 µm dia. drilling. The drill bit life is extended by 7 times at the 75 µm dia. drilling compared with 160 kmin-1 spindle speed.

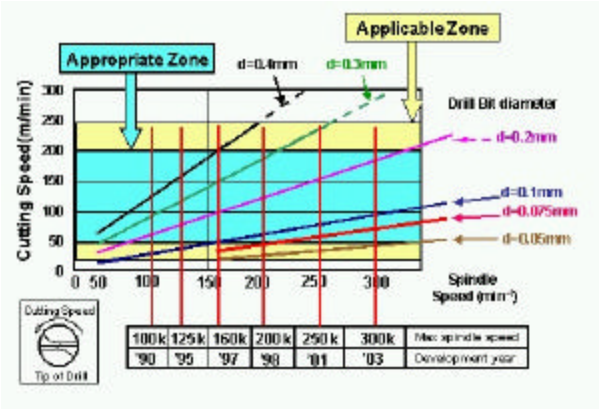

Figure 4 - Appropriate Cutting Speed for PCB

Figure 5 shows the drilled hole positioning accuracy result, with 75 µm dia. after 78,000 holes drilling. The hole quality is still good.

As a summary, the productivity and the position accuracy of T/H 75 µm dia of the core material are drastically improved by the mechanical drilling.

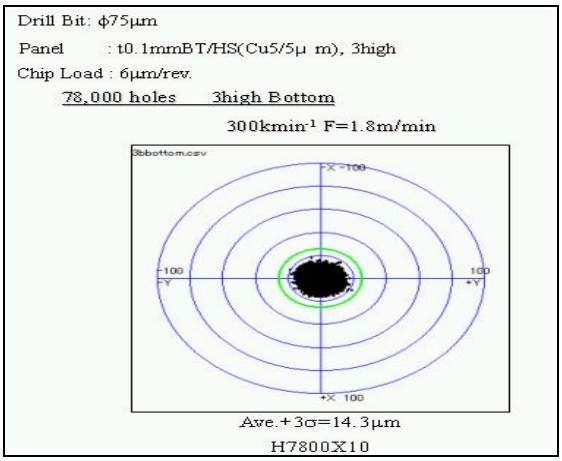

Figure .5 - Accuracy Result

CO2 Laser

There are two tasks of T/H drilling by CO2 Laser, one is to achieve Hole Roughness same as the mechanical drilling and the other is the Splashed Height reduction and Cu Overhang elimination.(Figure 7)

The Splash Height occurred at Top and Bottom, of the panel can be improved by Cu Surface Cleaning & Finishing process. Hole roughness is improved by selecting of insulation layer: PP and Glass & Filler.

Regarding Cu Overhang, it is possible to control Cu thickness and minimize the influence of the heat at Cu cutting into the insulting layer.

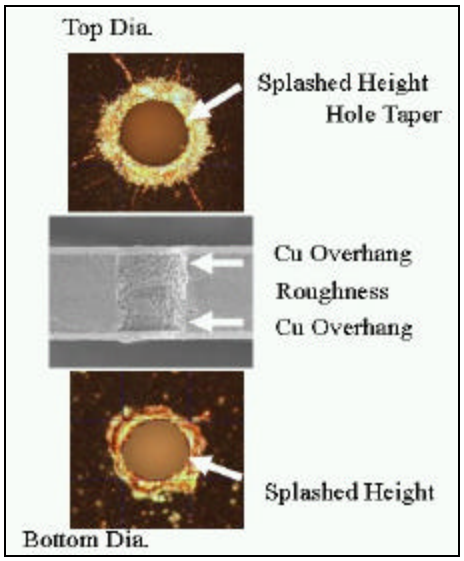

Figure 7 - Hole Quality for CO2 Laser

UV Laser

UV drilling also causes the Splash Height and Cu Overhang similar to CO2 Laser.

The Splash Height occurred at Top and Bottom can be improved by Cu Surface Cleaning & Finishing process same as CO2 Laser process.

As for Roughness it is possible to improve the process condition.(Figure 8)

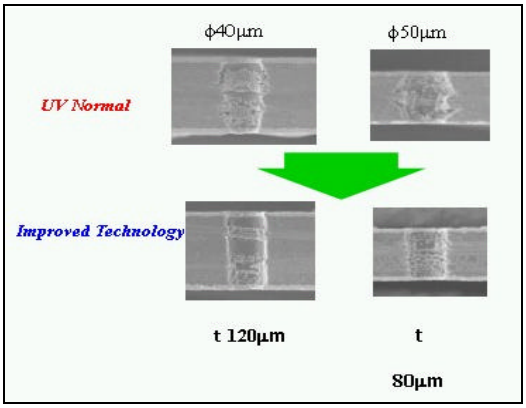

Figure 8 - Hole Quality for UV Laser

Summary

This paper describes the technical trend and task of the T/H drilling technology under 100 μm hole diameter. Regarding T/H by mechanical drilling is feasible down to 75 μm dia. with conventional PWB process equipment However, as for CO2 and UV Laser drilling, it is necessary to improve panel material and process condition. Therefore there are many breakthrough need to be overcome. Hope this paper would contribute to develop micro hole drilling technology.

References

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2 K. Matsumura, Micro via Drilling Technology, IPC Annual Meeting 2002, Sptember,2002,U.S.A