Union Tool's New Techniques Improve Tool Performance

The recent fundamental direction of printed circuit board (PCB) market is on the recovery path, mainly in the markets of China and Taiwan. More especially, there has been a remarkable trend for products related to package substrate. With this as a backdrop, Union Tool Co. has laid down four tasks in order to achieve its future goals for PCB production.

Recent Trends in PCB Market

The first task is to advance further the development for high efficient and reliable ultra-micro drilling technology less than ϕ0.1mm. The demand for ultra-micro drills less than ϕ0.1mm will surely increase because of tremendous improvement, such as capacity of memory, although the development of micro-hole application is slower than Union Tool's prediction that substrates such as Sip and POP using diameter less than ϕ0.1mm will shift to more micro specification as shown in Table 1.

In the situation of PCB, the material is being changed to cutting resistant material due to many kinds of filler content that are developed in order to reinforce mechanical characteristics such as heat resistance. This calls for the company's second task of meeting the demand of drill bit, which realizes excellent positioning accuracy and long tool life for that kind of PCB material.

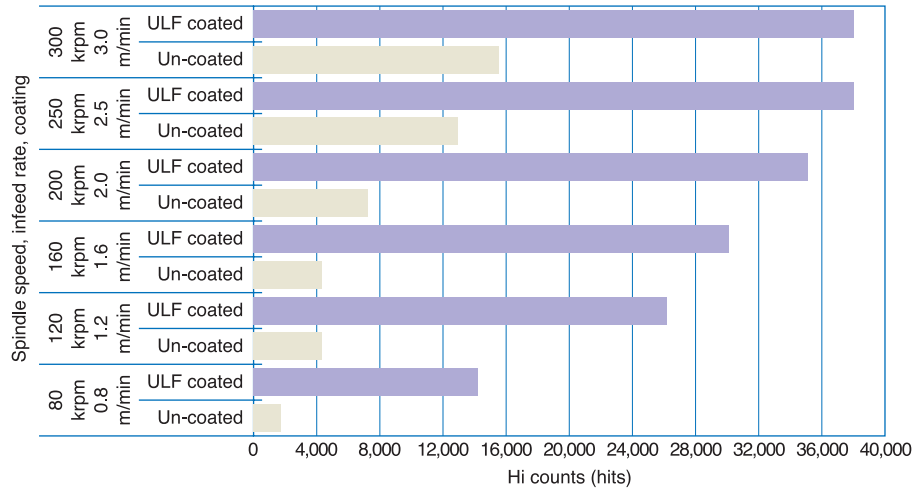

Fig. 2: Comparison of tool life until breakage using various spindle speed

The third task is to develop tools with the concept of "Recycle", "Reduce (Usage reduction of rare metal)", and "Reuse (Repointing)," in order to contribute resource saving of cemented carbide, which uses rare metals such as tungsten and cobalt. The fourth task is to develop tools that can increase panels per stack, and can be used with longer tool life in order to reduce drilling cost in customer's production.

Union Tool's new products, which were developed in consideration of their four goals, are introduced in following sections.

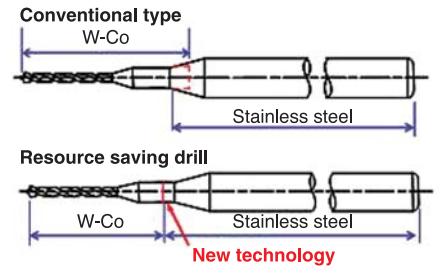

Fig. 3: Difference between conventional type and resource saving drill

Features of ULF Coated Drills

Micro drill bits of around ϕ0.1mm do not have strong body rigidity and not have enough peripheral speed (spindle speed) for drill bits less than ϕ0.1mm with conventional spindle-attached drilling machine. Because of this, drill breakage problem often occurs and suffers difficulty in trying to increase panel stack height to reduce the cost of drilling. Union Tool treats such anti-breakage performance as important, and develops diamond-like car-

Table 1: Roadmap of ultra-micro drilling

	2006/07	2006/08	2006/09	2006/10	2006/11
Land diameter (μm)	250	235	200	175	150
Land diameter (μm)	120	105	80	75	70
Resistration accuracy (μm)	±40	±35	±30	±25	±25
L/S (μm)	30/30	25/25	20/20	17/18	15/15

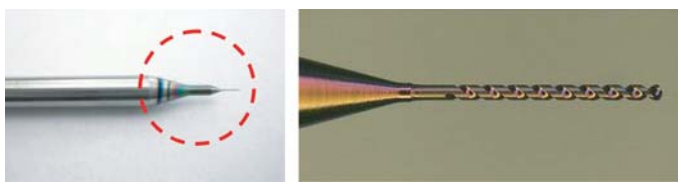

Fig. 1: ϕ0.1 mm ULF coated drill bit (left) and drill flute (right)

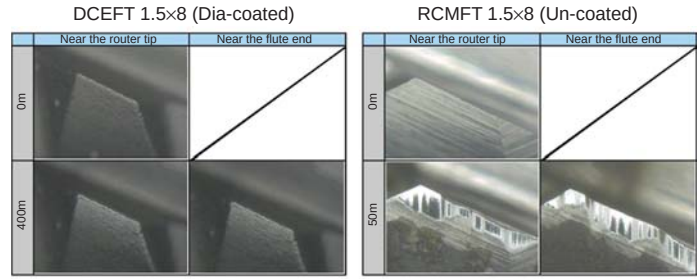

Fig. 4: Comparison of dia-coated and un-coated cutting edge wear

bon (DLC) coating to act s lubricant film that helps to improve chip evacuation efficiency of ultra-micro drill bits.

Drilling evaluation of ULF coated drill

Because the chip evacuation efficiency is improved by applying ULF coat to drills, resulting on high drilling performance even under severe condition when compared to conventional drills (Fig.1).

Fig.2 shows the drill breakage comparison graph of un-coated and ULF coated for ϕ0.1 mm drilling using various spindle speed. Generally, the chip evacuation efficiency will extremely worsen if suitable peripheral speed is not attained. Using un-coated drill, the results are remarkably worse with low spindle speed when compared to high spindle speed. However, using ULF coated drills showed less breakage than un-coated drills, and attaining about 10 times longer life when compared to non-coat drills at spindle speed of 80krpm. Furthermore, the drilling life increased drastically on high spindle speed than un-coated drills, making it possible to have stable drilling.

Apart from package substrates, ULF coated drills are expected to be effective in the improvement of hole quality through better chip evacuation on flexible PCB along with longer life. At the same time, improves as well drill breakage and hole wall quality on high aspect ratio PCB such as high multilayer boards.

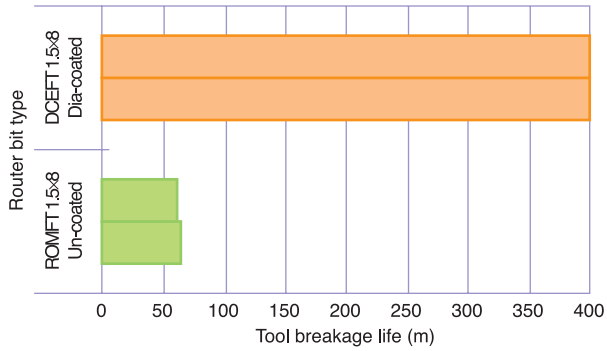

Fig. 5: Comparison of dia-coated and un-coated tool life

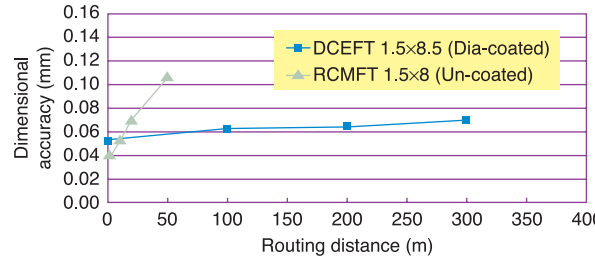

Fig. 6: Comparison of dia-coated and un-coated dimensional accuracy

Resource Saving Drills

Union Tool's conventional composite type drills were made by plunging method between W-Co type cemented carbide for cutting part of the drill and stainless steel for the shank. On the other hand, the company has adopted new composite method to resource saving drill, which eventually succeeded in reducing cemented carbide by 40 to 50 percent compared with conventional type without deteriorating the drilling performance.

Development of Diamond Boating for Routers

Just like the PCB drilling, the routing of PCB has also advanced for miniaturization and high accuracy routing pattern, where the elimination of swarf, burrs, among others, is needed through efficient improvement and low manufacturing cost. As a plan to reduce manufacturing cost, Union Tool, having the diamond coating technology, has developed a router that has upgraded performance in many aspects than existing routers.

Effectiveness of diamond coat

Usually, when routing the PCB, cutting edge wearing leads to problems such as breakage. However, applying the diamond coat on router, the cutting edge wearing is controlled widely, making it possible to avoid breakage and achieve accuracy. Fig.3 shows the cutting edge condition of diamond coated router and un-coated router. The cutting edge of un-coated router has high wearing at 50m routing, whereas the cutting edge of diamond-coated router shows almost no wearing even after 400m routing.

Routing evaluation of diamond coated router

As a comparison evaluation for diamond coated router and un-coated router, Fig.5 shows the tool life, while Fig.6 shows the routed dimensional accuracy. The un-coated router breakage occurs at an early stage, where as the diamond coated router does not break even after 400m. It also confirms very less diameter reduction and is still able to maintain good dimensional accuracy even in latter routing. This shows that the manufacturing cost can be reduced as the usage number of router bits can be controlled.

Future Prospects

It is now possible at present to improve the tool performance widely than before other than through ULF coat and diamond coat technology. Furthermore, new composite method for drill bits has been successful to reduce the usage of cemented carbide. Also in the future, research and development (R&D) will be continued, contributing to performance improvement and cost reduction. ❑