Novel Coating Materials Heighten Performance of Drills, Routers

When drilling printed-circuit boards (PCBs), a suitable peripheral speed is often unobtainable when using low spindle speed machines for micro drilling, resulting in problems such as drill breakage. Additionally on drill sizes such as φ0.2 and φ0.25, the drill rigidity is decreased to offer improved chip removal and this also adversely affects hole positional accuracy when drilling PCBs that need high chip removal efficiency.

Union Tool Co. has developed the ULF or Uniontool Lubricant Film coating with the new diamond like carbon (DLC). The ULF coating is a lubricant coating material that solves this problem by improving chip removal efficiency.

Features of the ULF Coat

Controlling the friction coefficient is a key feature of the ULF coating, maintaining a high degree of lubricity. Union Tool's comparison of friction coefficient was carried out using a ball on the disc test between a test ball (tungsten carbide) and a ULF coated ball (Fig. 1). This evaluation confirms the friction coefficient of the ULF coat to be less than half that of the friction coefficient of the pure test ball, that is about 0.6. From this, drills coated with the ULF coating offer very smooth chip removal during the drilling process and almost eliminates problems, such as drill breakage and bad hole wall roughness due to chip clogging.

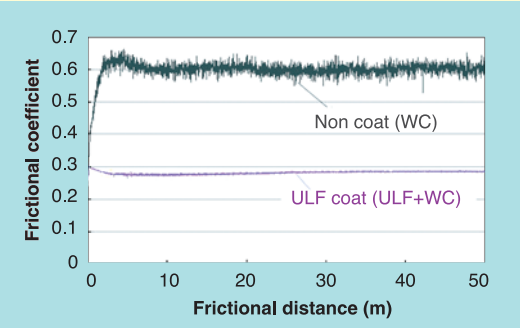

Fig 1: Comparison of friction coefficient evaluation

Drilling Evaluation

By coating the drills with the ULF coating, a clear improvement in chip removal efficiency during high-performance drilling can be seen even under the most severe conditions when compared to conventional non-coated drills.

Fig. 2 shows the drill breakage comparison graph of non-coated and ULF-coated drills for φ0.1 drilling using various spindle speeds. Generally, chip removal efficiency will deteriorate if suitable peripheral speeds are not attained. Using non-coated drills, the results are remarkably worse with lower spindle speeds or low peripheral speed when compared to high spindle speed or suitable peripheral speeds. However, using ULF-coated drills, less breakage occurred when compared to non-coated drills, attaining about 10 times longer life at a spindle speed of 80krpm. Furthermore, the drill life greatly increased on higher spindle speeds compared to the non-coated drills, offering very stable drilling conditions.

Fig. 3 further supports this by comparing the drill life until breakage/failure under various chip loads. At high chip load, the life of the non-coated drill reduces due to inefficient and poor chip removal, but the ULF-coated drill makes it possible to drill without breakage, even at high chip load. In comparison to the non-coated drill, fast drilling is possible with the ULF-coated drill, improving productivity and reducing costs.

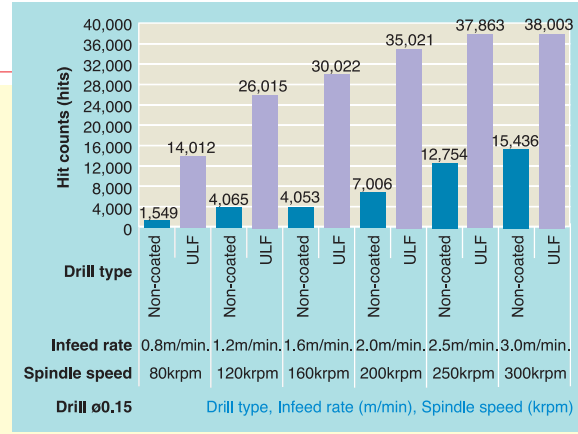

Fig.2: Comparison of tool life until breakage using various spindle speed

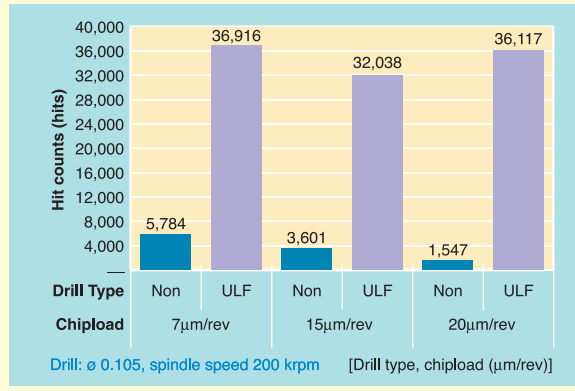

Fig.3: Comparison of tool life until breakage using various chipload

Development of Diamond Coating for Router Bits

In PCB drilling, the routing of PCB also has to advance for miniaturization and high accuracy routing patterns where the elimination of swarf, burrs and others are needed to be done with improved efficiency and lower manufacturing costs. In order to reduce the manufacturing cost, Union Tool has developed a diamond coating technology that upgrades router performance in many aspects over existing routers.

Effectiveness of Diamond Coat

Usually when routing a PCB, the cutting edge wears, leading to problems such as breakage. However, by applying a diamond coating on the router, the cutting

edge wear is more controlled, making it possible to avoid breakage and poor accuracy. Fig. 4 shows the cutting edge condition of a diamond-coated router and non-coated router. The cutting edge of the non-coated router already shows signs of wearing at 50m distance of routing, whereas the cutting edge of the diamond-coated router shows almost no wearing even after 400m of routing.

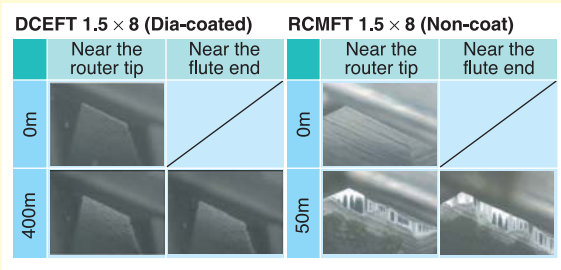

Fig. 4: Comparison of non-coated and coated cutting edge wear

Routing Evaluation

To evaluate and compare the diamond-coated router against a non-coated router, the tool life is shown in Fig. 5, while Fig. 6 shows the tool diameter reduction. Fig. 7 shows the routed dimensional accuracy.

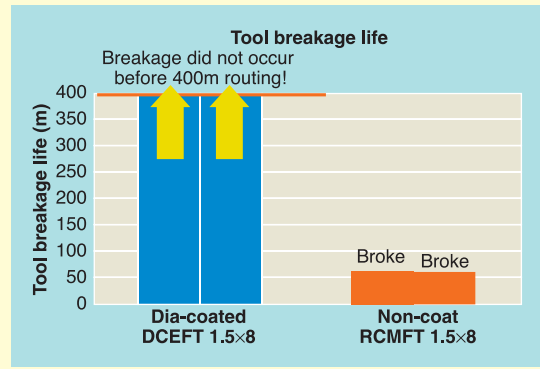

Fig.5: Comparison of non-coated and coated tool life

Breakage of the non-coated router occurs at an early stage whereas the diamond-coated router does not break even after a distance of 400m. This evaluation also confirms a much lesser amount of diameter reduction. Also, the diamond-coated router is still able to maintain good dimensional accuracy even in the latter stages of routing. Accordingly, manufacturing costs can be reduced as the number of routers required to rout the same distance is substantially decreased.

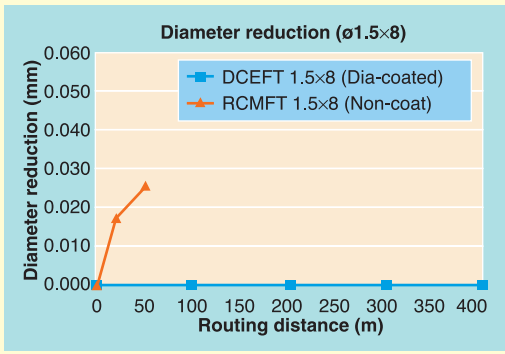

Fig.6: Comparison of tool diameter reduction

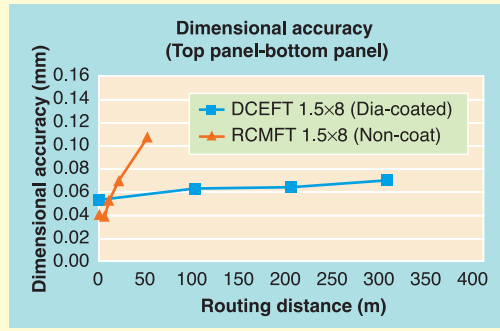

Fig. 7: Comparison of non-coated and coated dimensional accuracy

Future Prospects

It is now possible to widely improve tool performance compared to the current non-coated products by using either the ULF coating (drills) or diamond coating (routers) technology. Research and development will continue in the future, contributing to performance improvement and cost reduction.

About This Article:

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