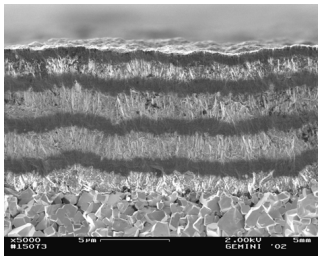
Diamond coated tools accept the challenges of the PCB industry

For a few years manufacturers of complex printed circuits boards have been facing additional hurdles with higher performance materials utilized for lead-free assembly, for microwave, harsh environment, telecommunication and medical applications. Halogen-free materials and laminates with different kind of fillers influence dramatically the performance and life of carbide tools normally used worldwide for machining of printed circuits boards. Reduced parameter and shorter tool life of drills and routers increase the production costs in the mechanical processing departments.
Ultimately, many manufacturers changed to diamond coated tools for the mechanical processing of printed circuits boards to fulfil the increased hurdles.

A. Basics about diamond coating process

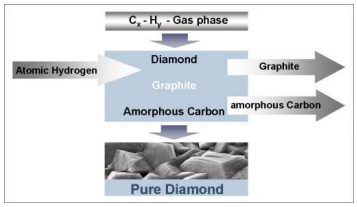
A special multilayer diamond coating, as shown in pictures 1 and 2, covers the working area of the tools.



picture 1: GCT diamond multilayer coating

Picture 2: GCT router type 1700

Real diamond coatings are produced only in a CVD process (**C**hemical **V**apour **D**eposition) as shown in pictures 3 and 4.



picture 3: CVD process scheme

picture 4: GCT diamond coating facilities

Because of the high process temperatures of >800℃ the CVD process require solid carbide tools made of approved carbide qualities. The coating cycle time depends on the coating thickness and can add up to 46h cycle time. Same depends on the application, diameter, geometry and tool type.

B. GCT diamond coating properties and ⇒ impact:

- extremely abrasion-resistant ⇒ lesser wear and longer mileage
- high level of hardness of 10,000 HV0.05 ⇒ lesser wear and longer mileage
- high heat conductivity ⇒ lesser wear and improved quality
- good surface slip ⇒ improved chip removal and quality
- high feeds during Al processing possible ⇒ higher productivity

C. Applications, advantages and examples

1. GCT router type 1700
- routing of inner and outer contours as well as for depaneling of assembled PCB
- ideally suited for halogen-free material, high Tg up to 185℃ and laminate with fillers
- significantly reduced burr formation and improved surface quality
- very high dimensional accuracy and process capability due to extreme rigid geometry

1.1 Process example:
- halogen-free material, board thickness 1.0mm, 3 pnl/stack
- GCT type 1700 Ø 1.0x5.20mm flute length
- spindle speed 48krpm
- feed rate 0.40m/min = 7mm/sec
- mileage ≥100m

1.2 Process example:
- halogen-free material, board thickness 1.0mm, 4 pnl/stack
- GCT type 1700 Ø 1.60x7.50mm flute length
- spindle speed 36krpm
- feed rate 0.60m/min = 10mm/sec
- mileage ≥250m

2. GCT router type 1750
- ideally suited for laminate with ceramic fillers and high Tg material ≥ 200℃; e.g. RO4350
- very high dimensional accuracy and process capability due to extreme rigid geometry and thicker diamond coating

2.1 Process example:
- RO 4350, 6layer board, thickness 1.80mm, 2 pnl/stack
- GCT type 1750 Ø 2.00x9.0mm flute length
- spindle speed 29krpm
- feed rate 1.0m/min = 17mm/sec
- mileage ≥50m

D. Key benefits of GCT diamond coated tools:

- cost savings due to better quality and tool life increase by factor 20
- increased productivity due to increase of feed rate by factor 3-4, less tool changing's and less handling
- process capability due to obvious less tool wear and higher dimensional accuracy

E. About GCT

Since 2003 GCT GmbH in Weingarten/Germany, develops, produces and sells worldwide diamond coated tools for the mechanical processing of printed circuits boards and for other products in the electronic industry. Today GCT GmbH is worldwide the leading manufacturer of diamond coated tools for machining PCB.
In 2010 the YoY net sales increase was 84% or 600k diamond coated tools. In 2011 the capacity is supposed to increase to 100k /month. Main markets are Europe, China, Taiwan, Korea and USA.
For more information, please visit www.gctool.com. For personal consulting please contact Mr. Johann Schmidt, Technical Head of GCT GmbH, under johann.schmidt@gctool.com.