

The Perfect Shape of Diamond Tools

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Sample material:

1. PCD
2. CVD
3. SCD (MONO type)

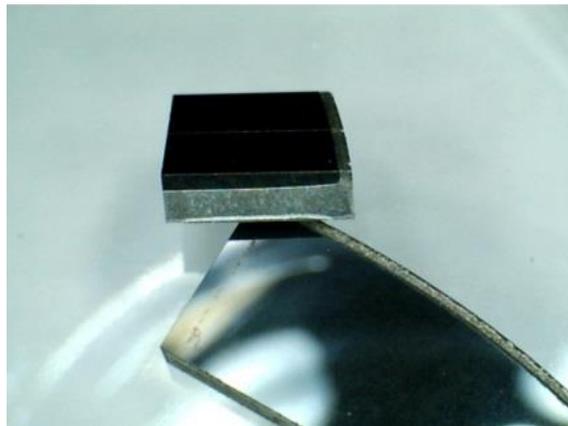
The following pictures show the very high quality of the cut on each type of material.

1. PCD – total thickness 1.6mm

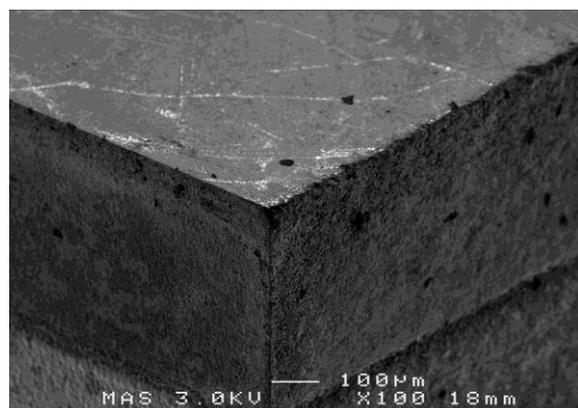
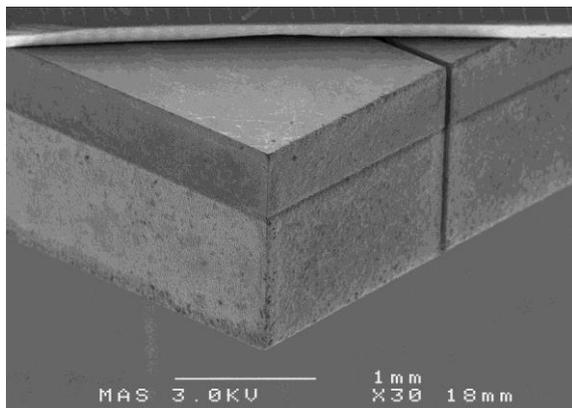
The sample supplied was from the edge of a mother disc. A cut was made radially. (The reduction in PCD layer thickness near the edge of the disc is visible).

The cut with the wet laser is silver in colour on the carbide (a wire cut flank is usually 'gold' coloured from the brass wire used).

The cut with the LMJ was made from the PCD side down into the PCD layer and then into the carbide layer.

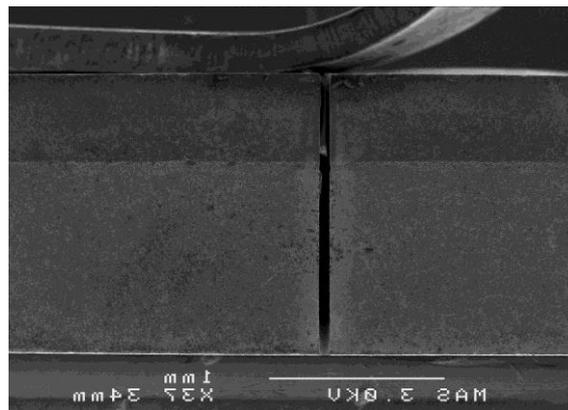


Below left: the left side of the PCD has been cut by the LMJ wet laser. The right hand side was wire cut. In particular, one can see that a chip free edge has been produced by the wet laser.



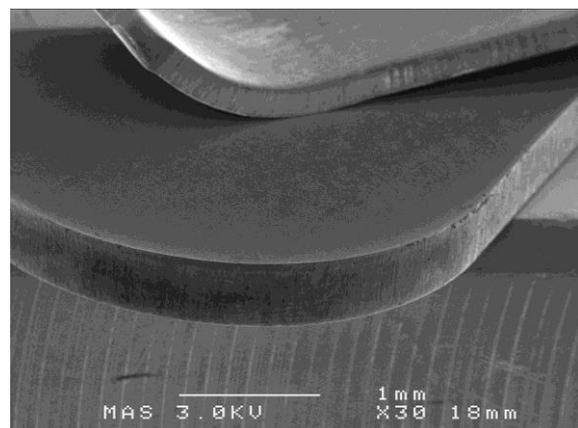
Above right: at 100x the perfection of the wet laser cut edge on the left is very clear to see. On the wire cut (right) flank one can see the preferential erosion at the interface between the PCD layer and the carbide substrate. This is because the interface here has a higher cobalt content and so is more electrically conducting. The LMJ cut flank is smooth and continuous – there is no step or trench at the interface.

Below: this image shows another cut made by the LMJ. One can see it is perfectly parallel sided. The laser water jet has entered the PCD from the top. The cut was stopped intentionally just before the sample was cut through completely. One can see straight down the cut to the other side of the PCD. The width of the cut is 60 microns. There is a spring clip in the background holding the piece onto the SEM holder.



2. CVD plate – 0.5mm thick

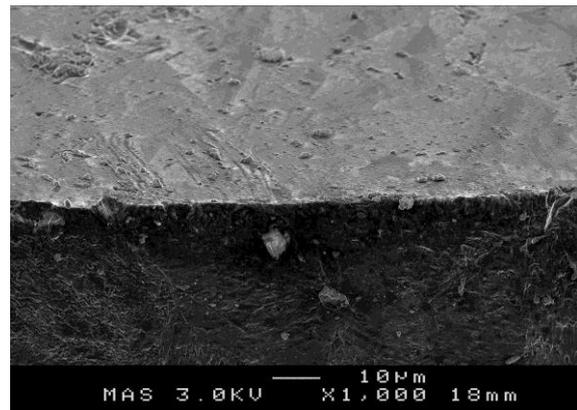
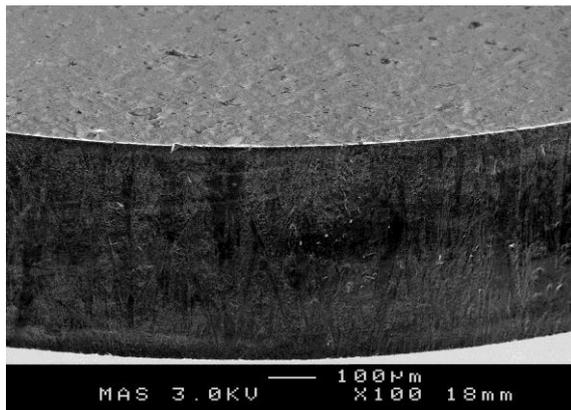
Below left: the shape cut with the LMJ.



Above right: the radius at x 30 magnification.

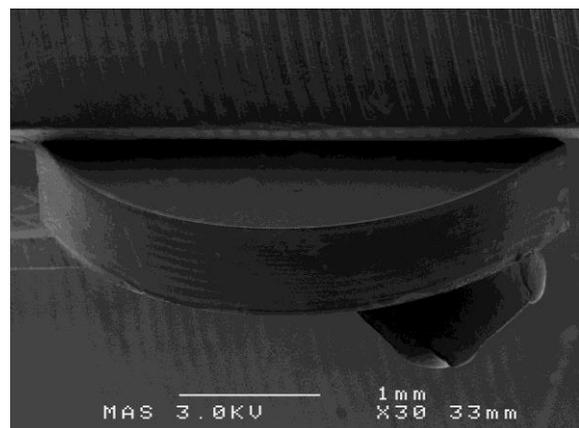
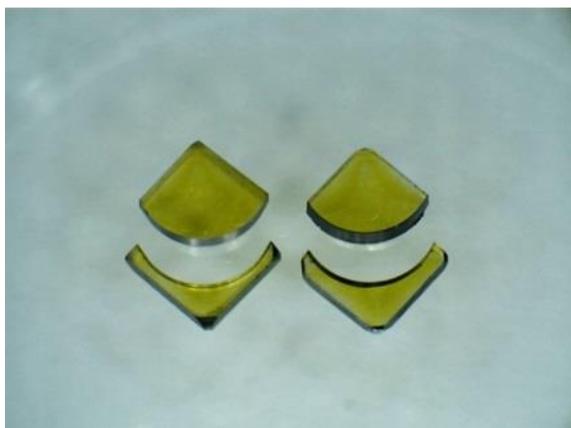
Below left: the radius is chip free at x100. There is a small piece of dust on the edge. The columnar structure of the CVD diamond growth is visible.

Below right: at x1000, the CVD edge is sharp and with negligible radius.



3. MONO type single crystal diamond – 700 microns thick

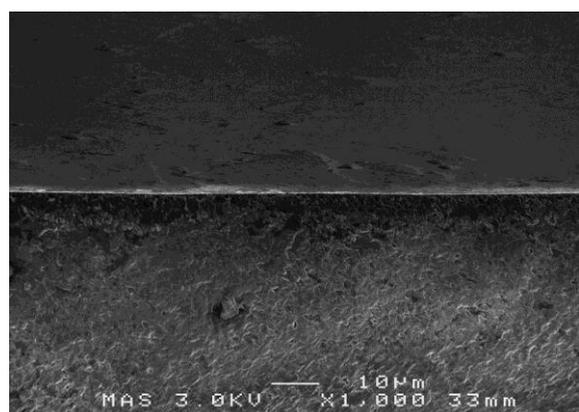
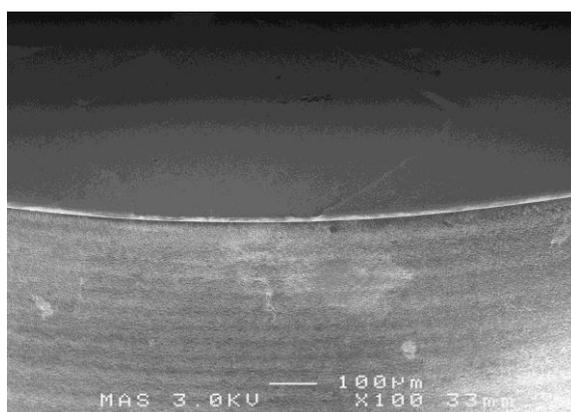
Below left: the pieces supplied were cut as shown below. During cutting, a very thin layer of black carbon forms on the cut surfaces. This is easily removed during the finish radius grinding.



Above right: the SCD in the SEM holder

Below left: the cut edge at X100. It is chip free. The edge is sharp (0 deg clearance).

There is some electrical charging of the diamond in the SEM which gives the white colour on the edge.

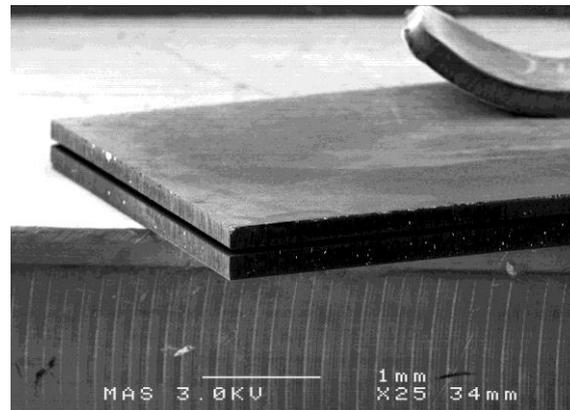


The flank is very smooth. There is some slight contrast produced showing how the laser scanned back and forth. The scan lines indicate how much material is removed with each pass

Above right: Even at 1000 x magnification the edge is sharp. Very little carbon debris is visible (the samples were not been cleaned after cutting). There is virtually no radius.

If the tools are to be used 'as cut' brushing the edges (as is done with PcBN tools) will remove the carbon deposit and condition the edge.

Finally, one more image to show: It is of a piece of CVD diamond 6 x 5mm and of a thickness 0.5mm. The LMJ has been used to 'slice' the piece in half. One can make savings by buying larger pieces of diamond and then cut very thin slices and make tools. In this case the slices produced are approx. 0.22mm thick.



The LMJ Laser MicroJet can cut all these materials with ease and the cut quality on the flanks is smooth, the cuts are straight and the edge which will become the cutting edge is sharp.