

Processing machines for PCD cutting tools for the flat screen market

Scribing tools for the production of glass plates for flat screens are subject to substantial quality requirements. Bore holes with a typical diameter of 0.8 mm have to be produced with a concentricity better than 0.002 mm. Such severe demands are not an easy task for tool manufacturers, this is particularly true for the increasing use of PCD scribing tools, as described here by **P. Mikhail**.

In today's pocket calculators, PC monitors, notebooks and mobile phones, liquid crystal screens are omnipresent.

High growth rates are attained with the new large size flat screens equipped with liquid crystal technology. With their extremely sharp picture quality, they bring cinema atmosphere right into the home. The vision of hanging a TV set on the own wall, which goes back as far as 1960, has just over 40 years later become a reality and even starts to become the standard. In addition to LCD screens, plasma screens also have to be mentioned. Both technologies are based on the precise placement of electronic and chemical components between two glass plates. For the production of these glass substrates the glass industry

requires small cutting or scribing tools. The most common scribing tool, often called a scribing wheel or glass cutter, has an outside diameter from 2 to 6 mm. One of its main quality factors is the maximum allowed concentricity error (tolerance) of 0.002 mm. Therefore, the quality of the hole with a diameter of, for example, $0.815 \text{ mm} \pm 0,002 \text{ mm}$ plays an important role and represents the base for the subsequent treatment of the cutting edge. Another important criterion is the surface quality of the cutting edge which is shown in Fig 3.

Roundness of 0.0015 mm at 0.8 mm bore diameter

Usually these scribing wheels are made of tungsten carbide or polycrystalline diamond (PCD).

The market trend goes more and more toward the PCD scribing wheels, because of the hardness of the material. Substantial longer working times are achieved, therefore the downtime for setting-up and changing of the tools can be reduced. Furthermore the high quality of the edges lead to considerably better results so that subsequent working steps are minimised.

Scribing wheels, as shown in Fig 2, consist of a solid PCD material of 0.65 mm thickness and an outside diameter of 2 to 6 mm. The diameter of the central bore is approximately 0.8 mm.

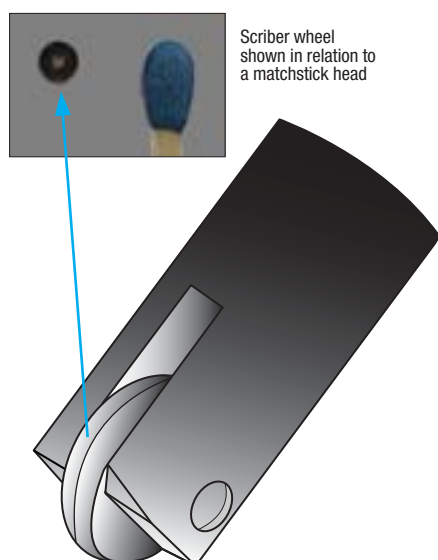
In the manufacture of scribing wheels, the blanks run through two main treatment processes:

- ◆ diameter calibration and shaping of the hole
- ◆ grinding of the cutting edge

For the calibration of the inside diameter, a roundness better than 0.0015 mm is necessary. These values can be achieved by means of a CorBore 800, an implementation of the mbs-procedure



Fig 1 Flat screens are a big trend of today



Scriber wheel shown in relation to a matchstick head

Fig 2 Typical scribing wheel made of solid PCD

(Micro Bore Sizing). Stock removal amounts to typically 40 to 50 μm for a given hole length of 0.65 mm.

The treatment with loose diamond grains enables an efficient and economic process to achieve the highest quality of roundness, cylindricity, as well as surface and geometry tolerances. The big advantage compared to the conventional 'grandieren' (lapping/honing of inner diameter of watch sapphire stones) is mainly the fact that a fully automatic process can be run and therefore ideally suited for a mass production. Further advantages of the system are the high accuracy achieved through the inherent self-optimising lapping process, a high stock removal by the utilisation of the maximum possible tool cross section, an optimal tool load as well as the high process security. This cost effective solution is further enhanced by the simple and economical tools.

Machining with a 350 mm diamond grinding wheel

Special attention has to be paid on the work piece fixtures for the OD grinding process in order to get the required radial grinding pattern with a quality of the cutting edge of $R_a = 0,4 \mu\text{m}$ (Fig 3).

Fig 4 shows the Micro Centre 31, the automatic outer diameter and concentricity grinding machine for tungsten carbide and PCD glasscutters. With this machine outside diameters from 2 to 6 mm can be processed. The attainable concentricity amounts to less than 0.003 mm. The cutting angle of the scribing wheels can be worked out within the range of 115°

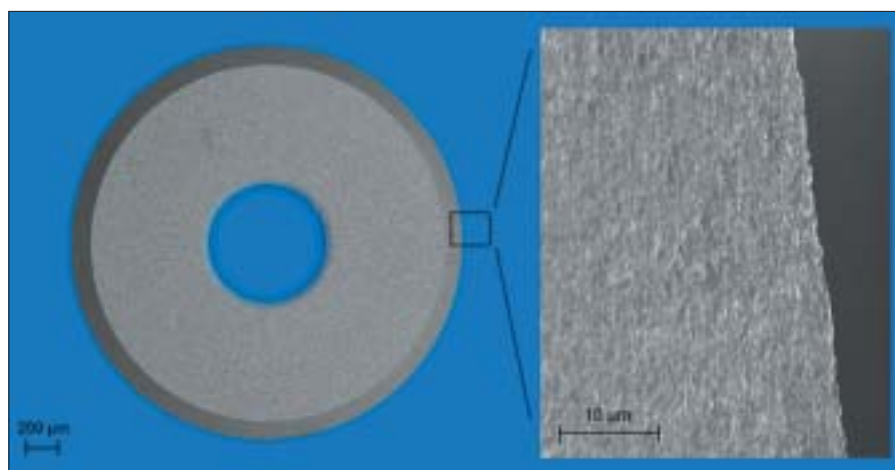


Fig 3 REM picture of the PCD side of a scribing wheel with enlargement of the cutting edge (dark ring on left side = polished cutting edge)



Fig 4 Automatic machine for grinding PCD and tungsten carbide glasscutters

to 150° and the sharpening texture between 45° and 90°. The process is carried out with a material allowance of approx. 0.2 mm, high cutting speed and small feed rate. Through the implementation of a 6 axis robot system, a fully automated process has been realised. For the treatment of PCD, the diamond grinding wheel with a diameter of 350 mm, as used here, represents a significant advantage in comparison with alternative technologies. They usually are limited to substantially smaller grinding wheels or pins. The large wear of the smaller grinding wheels or pins makes an efficient grinding of PCD impossible. The cycle time for the OD

grinding on the Micro Centre 31 amounts to approx 2 to 3 minutes for tungsten carbide and between 10 to 20 minutes for PCD tools, depending on the necessary material removal and the required quality. ♦

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Figs 2, 3 and 4: **Microcut Ltd.**

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