

Manufacture of Moulds Using Single Point Diamond Turning Techniques



PRECISION-OPTICAL
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DM 005

The single point diamond turning (SPDT) process is an extremely well established technique for producing components with complex surfaces, and is widely adopted for the manufacture of a variety of precision mechanical and optical parts. In addition to the direct production of aspheric lenses and mirrors and diffractive lenses, diamond turning is also an excellent technique for producing injection mould tools. Optical components manufactured by injection moulding techniques are as diverse as contact lenses, aspherical lenses of CD-players, high quality car spotlight reflectors with Fresnel structure or packaging materials with Fresnel lenses for cosmetics. In addition to being able to produce complex surfaces, SPDT produces a high quality surface finish, with surface roughness of the order of nanometres. Moulds can be produced to internal design specifications or to customer specifications.

SPDT Lathes

The cutting tool used on SPDT systems is a single crystal natural diamond which possesses nanometric edge sharpness, form reproducibility and wear resistance. There are a number of variations available, but for the manufacture of optical components, natural single crystal gem quality diamonds of approximately half a carat are used. They are precision ground and orientated to provide maximum strength and wear resistance. SPDT lathes are available in a variety of sizes and capacities, with some capable of accommodating components up to 700 mm diameter. Diamond turning can be used with a comprehensive range of optical materials and metal alloys. Mould tools can be machined in aluminium alloys, OFHC copper and copper alloys, brass, bronze and electroless nickel.

Material considerations

Circular or square section bar material is preferred over rolled plate material and should be stress relieved prior to diamond turning.

Mould examples

A recent application of the use of diamond turning to produce moulds was for a retail packaging project. P-OE's expertise in optical component design and diamond machining was utilised to produce moulds used for injection moulding of eye-catching acrylic gift sets for toiletries for FCUK. These were designed for exclusive sale in The Boots Company's retail stores throughout the UK. Key to the design is a large, moulded Fresnel lens on the front of the presentation box which magnifies the product name from a variety of angles as the shopper walks past. A number of lens moulds were manufactured and each mould was nickel-plated to minimise wear.

Application Note



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Micro lens applications

Mould tools have also been produced for microlens arrays.

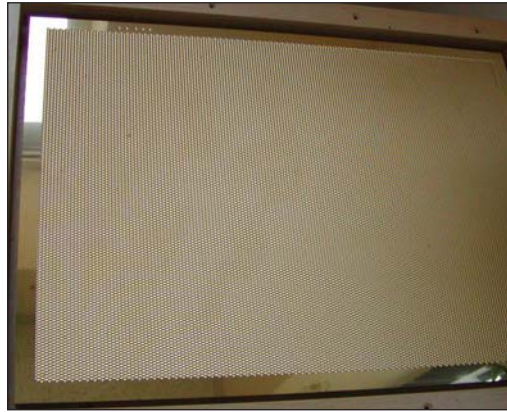


Figure 1

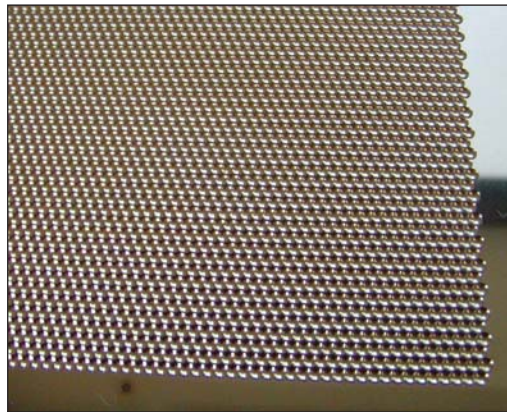


Figure 2

Figure 1 shows a complete mould array, whilst Figure 2 shows some of the individual moulds. The sizes of these can range up to arrays of thousands of lenses. The lenses in microlens arrays are generally spherical. Microlens arrays are used in applications as varied as large screen projectors, directional LED projection, stop lights on cars and high brightness traffic lights. When used in conjunction with LEDs, the arrays give high brightness at low power.



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