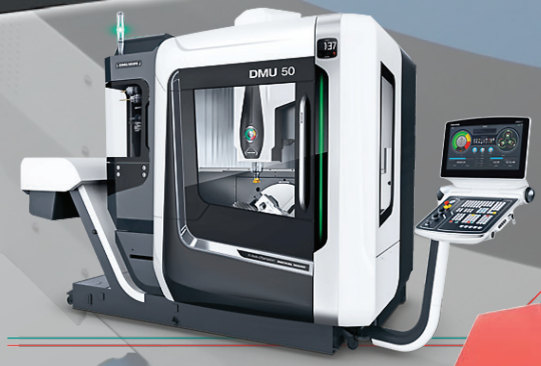
Zephyr Studies

Polishing of Small Optical Moulds Tungsten Carbide

ZEEKO Ltd



Polishing of Small Optical Moulds Tungsten Carbide

Case Study

Polishing Small Optical Moulds: Tungsten Carbide

Zeeko is a well-known name in optics fabrication, building what is probably the most accurate polishing machine for freeform optics in the world. Using its own software and process technology, these machines have polished some of the best-known telescope and satellite optics yet produced, including many very complex X-ray telescope mandrels.

The Zeeko process for optics polishing has become well developed and mature over the years, and out of this work has recently evolved new tools, new software and new processes. Amongst these developments, processes have emerged that have made possible the automatic polishing of precision moulds for numerous applications including Head Up Displays (HUD's), precision injection moulds, precision moulds for glass press moulding of small lenses and now the polishing of moulds for the production of curved coverglasses for mobile phones screens.

The market for such lenses is growing quickly for numerous applications including cell-phone cameras, sensors, surveillance cameras and a many automotive applications for small moulded glass precision optics.

This case study addresses one of those new developments: the polishing of moulds for the glass press moulding of precision optics for cameras and other applications. The moulds had been prepared by the customer by grinding and the requirement was to improve both the roughness and the PV without in any way degrading the form.

The requirement was first to remove the grinding wheel marks or "mid-spatials" and then to correct the form. Zeeko chose to use an IRP 50 machine and a new (and still experimental) polyurethane tool of radius R = 0.4mm for this case study.

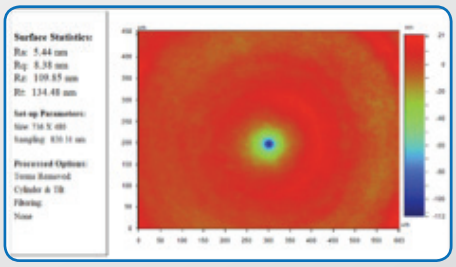
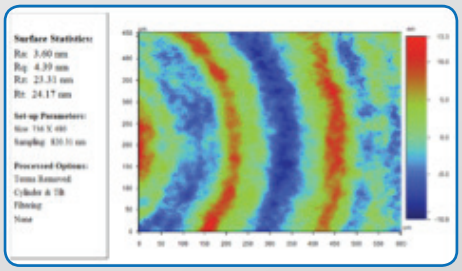
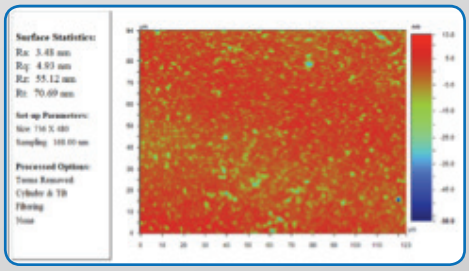
The Mould being Polished on an IRP 50

Measured on Panasonic UA3P

Initial Condition

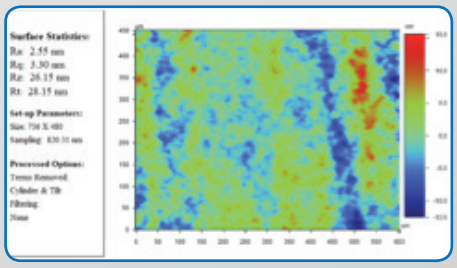
INITIAL CONDITION
Ra = 5.44nm to Ra = 3.07nm

The surface roughness of the ground sample in central and edge areas were measured to be Ra 5.44 nm and Ra 3.07 nm and from the images of the surface below, it can be observed that the grinding wheel mid-spatials and fracture induced pits were visible on the surface:

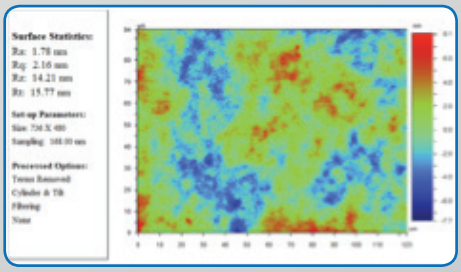




AFTER POLISHING (approx. 30 mins) Ra=1.7nm – 2.55nm (Spec Ra=3.0nm)

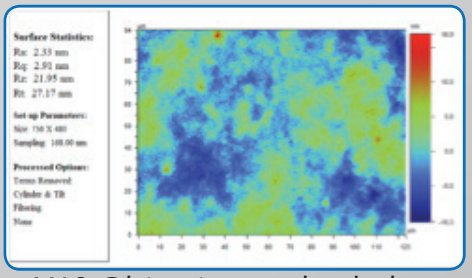
Following the first polish these marks were eliminated:



X50 Objective to check the roughness at the centre

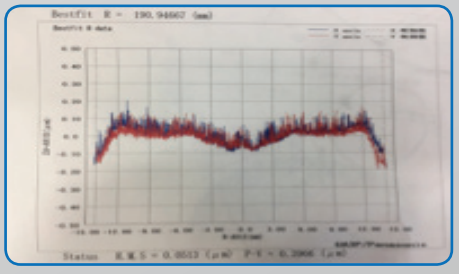


X50 Objective to check the roughness at the edge

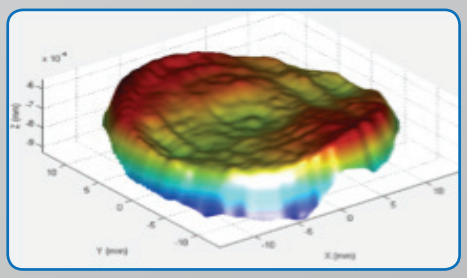


X10 Objective to check the absence of grinding lines

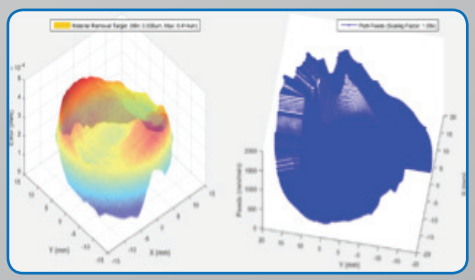
Following the first polish the form error was measured at P-V 0.3966µm:



P-V = 0.3966µm

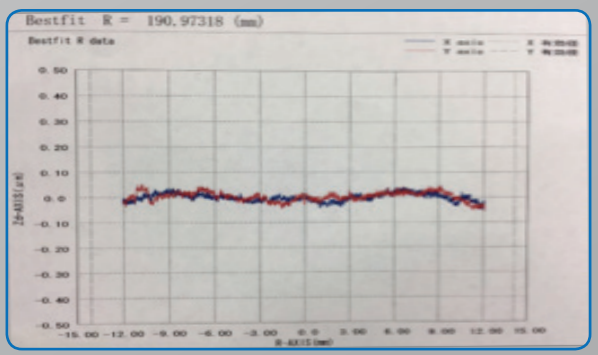


Full 3-D Error Map to be imported to ZephyrCAM



From the error map the removal targets and moderated feed rates are calculated

AFTER 3 CORRECTIVE POLISH RUNS PV=0.1µm



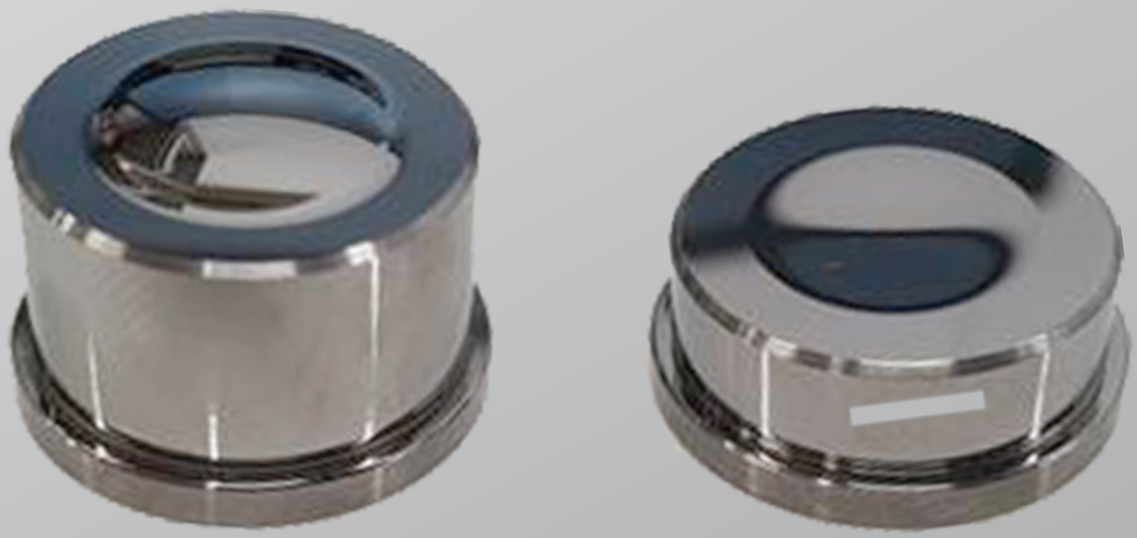
Conclusion

1. The Zeeko polishing process clearly demonstrated its ability to quickly to remove fracture pits (approx. 30mins), grinding mid-spatials and the general roughness on the surface of the sample reducing the measured result from Ra 5.5nm to between Ra 1.7nm and Ra 2.55nm clearly better than spec (Ra 3nm).

2. The corrective polishing process also demonstrated its ability to converge the PV error with each polishing run. The result showed a reduction of the error from PV 0.4um to PV 0.1µm (with convergence still being demonstrated). 3 polishing runs – each of 30 mins approx. were performed.

3. Can the process be faster: Yes - If the starting condition is similar to the starting condition of this sample part – with an efficient polishing process (without wasted polishing runs) and using the new Zeeko hi-speed head the tool can be run at 12,000rpm.
With these changes Zeeko predicts the same result can be achieved in less than 30 mins.

4. Meanwhile it should be noted that, bundled with the ZephyrCAM polishing software are the Zeeko ZephyrMill and ZephyrGrind options. These are respectively just what they say; full feature freeform milling and grinding software packages and within those options, is the capability to correctively grind and correctively mill the surface. In this instance it may be beneficial to consider installing the ZephyrGrind software to the grinder used to prepare this mould as it may produce a higher accuracy grind than the customer part submitted here for polishing.



Please contact info@zeeko.co.uk or call +44 1530 815 832
for further information on this study, to order tools or to request
a 30 day free trial of the ZephyrCAM software

Zeeko Ltd | 4 Vulcan Court | Vulcan Way | Coalville | Leicestershire | LE67 3FW | United Kingdom
www.zeeko.co.uk