PO1052

Ion Beam Figuring (IBF) of High Precision Aspherical Optics

Frank Allenstein[1], Michael Zeuner[1], Marcel Demmler[1], Thoralf Dunger[1], Matthias Nestler[1], Sven Kiontke[2]

[1]Roth & Rau MicroSystems GmbH, Hohenstein-Ernstthal, Germany [2]asphericon GmbH, Jena, Germany

frank.allenstein@roth-rau.de

Recently and upcoming optical applications depend more and more on the precision of the optical elements used. The last is especially driven by shorter wavelength, higher flux densities and imaging close to the diffraction limit. Therefore a dramatically increasing demand on high precision and high quality optical components in leading edge equipment as well as common devices and instruments is observed.
So far a few methods have been introduced to provide an adequate manufacturing performance using mechanical grinding and polishing techniques. Up to now the very sophisticated ion beam figuring (IBF) has not been used for common optics. The reasons for this might be the perception of higher costs and less knowledge about the technique in the industry.
Now an affordable ion beam figuring technique has been developed to address precision aspherical optics applications. This paper introduces ion beam figuring technology based on equipment which is widely used in semiconductor mass production for ultra precise film thickness trimming.
Ion beam figuring works by raster-scanning a focused broad ion beam across an optical surface with variable velocity and dwell time in order to precisely and locally trim away surface contour errors.
As a new and cost effective approach the ion beam figuring system used in this presentation applies a 3-axis movement system only (compared to expensive 5-axes movements in other applications). X-and y-axes are used for the areal scan, and the z-axes is used for focus adjustment due to the surface contour of the optical element. The system was intentionally designed without the 2 additional tilt axes for incident angle adjustment and cleverly reduces the complexity and size of the system.
It is shown that curved spherical or aspherical surfaces can be corrected down to λ/50 or better by using the state of the art 3-axes trimming system. Even with high spatial frequency parts final processing qualities better than λ/10 are achieved.

Keywords
Ion beam figuring
ion beam milling
local correction
aspherical optics
high precision