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Sub-aperture ion beam finishing of optical mirror devices

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Modern short-wavelength imaging systems in the visible and UV spectral range are based upon complex figured mirror devices with a spherical, aspherical or free-form surface shape. Recently it has been shown, that the application of reactively-driven ion beam tools allows the direct surface figure error correction of mirror optics made from aluminium technical alloy materials AL6061 or AL905 [1,2]. With this innovative technology it is now possible to correct the figure error of the mirror surfaces up to 1 micron in height while preserving the surface roughness.
Non-toxic gases as oxygen and nitrogen are used for ion beam processing. The erosion process rests upon pure physical sputtering enabling a high degree of process control. For reasons of device shape flexibility a deterministic machining approach with a small-sized tool function is examined: First, a dwell-time algorithm is applied to transfer the figure error profile into a motion map. Following this simulated motion profile the ion beam is then moved deterministically along the device surface. This approach allows the figure error correction of huge and diversely shaped mirror devices.
As an example the figure error correction of a deep concave parabolic mirror with an aspect ratio of central depth to open aperture of □0.6 is focused. The contribution comprises technological aspects as the generation of a focused millimeter sized ion beam, the evaluation of different machining geometries within the particular ion beam erosion model scheme, and several trial process applications of reactive ion beam machining at aluminum sample devices.
[1] Bauer, J., Frost, F., Arnold, T.; J. Phys. D: Reactive ion beam figuring of optical aluminium surfaces; IOP; 2017, 50, 085101; DOI: 10.1088/1361-6463/50/8/085101
[2] Bauer, J., Ulitschka, M., Frost, F., Arnold, T.; EOS Optical Technologies: Figure error correction of aluminium mirrors by deterministic reactive ion-beam machining; Munich / Germany, 26.-29.06.2017

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