Development of 3D Nano-Structure Exposure System with High Performance PZT Nano-Stage

Chien-Chung Fu (傅建中)[1,2,3], Wei-Tai Lei (雷衛台)[1], and Bor-Yuan Shew (許博淵)[3]

[1]Department of Power Mechanical Engineering, National Tsing Hua University, Hsinchu, Taiwan
[2]Institute of MicroElectroMechanical System, National Tsing Hua University, Hsinchu, Taiwan
[3]National Synchrotron Radiation Research Center, Hsinchu, Taiwan

We have developed an innovative multi-axis 3D DXL machining system for 19A beam which consists of a high performance PZT nano-stage with 1nm resolution and a stroke up to 200μm. The new-developed control system simulates the dosage distribution and drives the stage moving along particular paths with high precision. With this advanced stages and the new-established characteristics of exposure dosis-development depth, the products are ready for forward machining to any free form surfaces. The maximum depth achieved by far is around 100μm. The surface roughness can be controlled below 20nm.

Fig.1 shows the built piezoelectrical nano-stage for 19A beam with mask-PZTstage coordinate aligning device which aligns the orientation of mask and PZT stage to insure that the moving directions of mask and PZT are equal. Fig.2 shows the simulated results and the confocal microscopic image of real manufactured curves by multi-axis 3D DXL machining system with overlapped stamped movement. With the control over elapsed time of moving mask on indicated locations, the corresponding structures will reveal after the development. Fig.3 shows the moving path and the simulated results of a concave lens by overlapped continuous movement and the corresponding confocal microscopic images of fabricated concave lens with dimensions of 16μm depth and 25μm diameter..

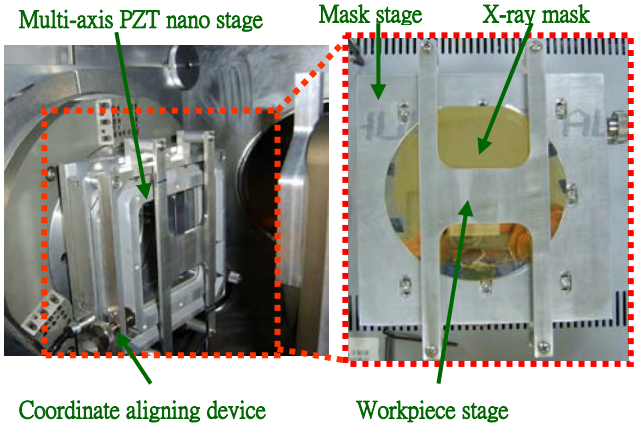

Figure 1. The setup of the piezoelectrical nano-stage for 19A beam.

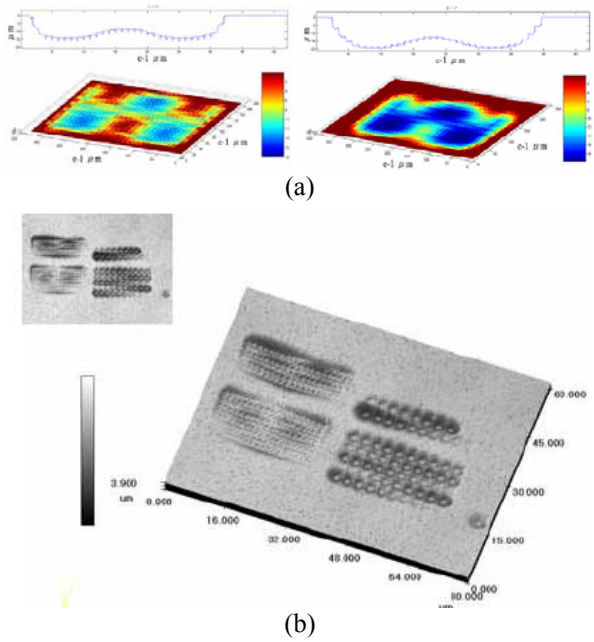

Figure 2. (a) The simulation results of the curves. (b) A picture of the fabricated curves by OLS3000 confocal microscope.

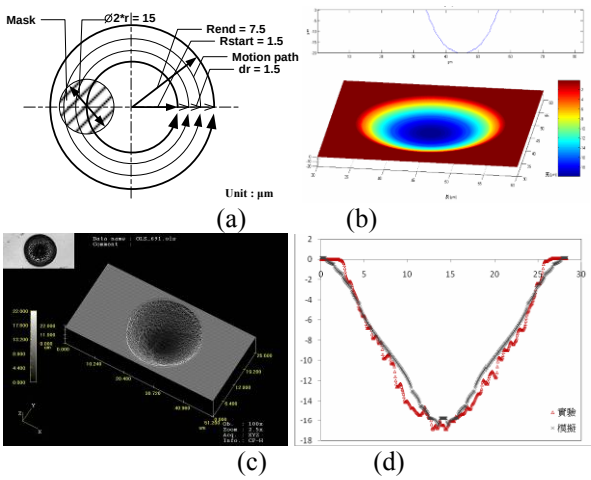

Figure 3. (a) The moving path of concave lens (b) The simulation of concave lens. (c)(d) OLS3000 confocal microscopic photographs of fabricated concave lens with dimensions of 16μm depth and 25μm diameter