

Fabrication of a rotation corrector for electron multi beam array micro-lenses.

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Multi electron beam systems are being developed for high throughput lithography [1] and for sub-10 nm direct write using multi-beam Electron Beam Induced Deposition [2]. Such systems have microfabricated arrays of electrostatic lenses consisting of 2 or more array electrodes that need to be mutually aligned with approximately 1 μm lateral. We have developed a flexible tool for stacking and aligning these microfabricated parts (see fig. 1). Parts can be aligned within 500 nm and fixed using various adhesive bonding methods. The tool is used for the accurate alignment of electrodes in various electron optical components in which micro fabrication and micromachining techniques are required. Examples where this system is useful tool; multi beams single source module [3], a novel aperture ion source (NAIS)[4][5], and a multi beam rotation corrector[6].

The latter is an important in-column correction element when two multi beam lens arrays need to be aligned. Translation errors are easily corrected using deflection fields, but rotation errors between arrays are less obvious to correct for (see fig. 2).

We have developed an electrostatic multi beam rotation corrector consisting of a 3-electrode electrostatic lens array stack in which the middle electrode array is slightly rotated. This way each individual lens in the array has a slightly shifted middle electrode, as a tangential function from the rotation center. The lateral focal position depends now on the shift and voltage of the middle electrode. Making it feasible to correct rotation array errors.

We will present the capabilities of the mechanical alignment tool and how it is applied in the fabrication of multi-beam components, in particular the multi beam array rotation corrector.

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[3] Mohammadi Gheidari, A., P. Kruit, Nuclear Instruments and Methods in Physics Research A 645, 2011

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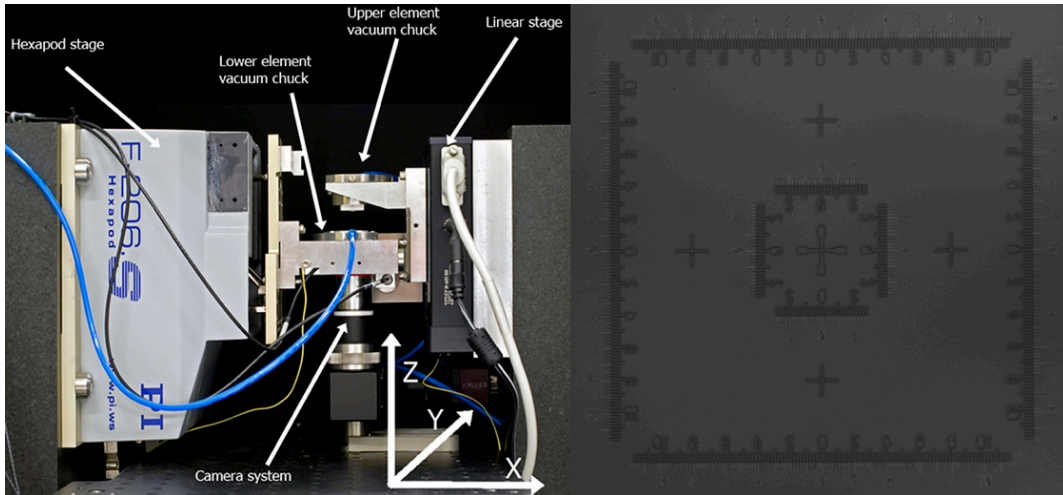


Figure 1: Left: Alignment tool for stacking microfabricated components. Right: Example of a glass plate with a vernier structure (bright ticks) aligned, and adhesively bonded, to a Si sample with another vernier structure (dark ticks). The mis-alignment between the two vernier structures is -83 nm in the horizontal direction and -250 nm in the vertical direction.

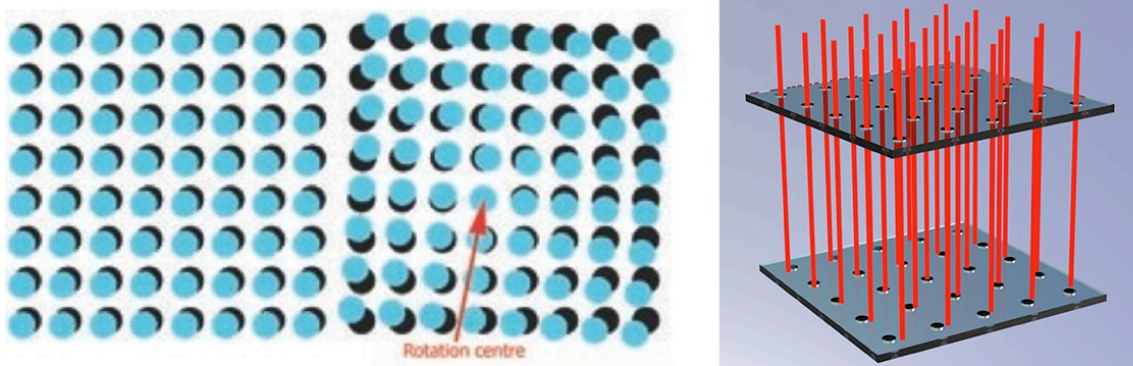


Figure 2: Left: alignment error solvable with x/y deflectors. Middle: rotation error where x/y deflectors are not sufficient for proper alignment. Right: 3D illustrative example of rotation misalignment in a multi beam system.