Microfabricated Registration Marks for Automated Location Calibration

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SUMMARY

The Location Finder calibration sample comprises a set of 32x32 cells embedding 2D coordinate information. Each cell represents a 2D bit pattern enumerating its position. The Location Finder when imaged with a particle beam and combined with image processing can be used to calculate the beam position with high precision. The design of the Location Finder can be scaled to be compatible with both optical and particle beam applications.

PURPOSE OF THE WORK

Positively biasing the sample in a low voltage FESEM is a technique used to increase the range of X-ray spectrum accessible to EDS [1] An unwanted consequence of this technique is the reduction of the secondary electron yield and magnification and image position change when a bias is applied. The Location Finder is used to calculate the image displacement and size as a function of the sample bias and X and Y location. The sample stage position is then corrected to compensate for the image shift so the scan areas in biased and unbiased sample coincide.

EXPERIMENTAL

The 2D structure of the Location Finder ~~sample~~ targeting SEM applications represents a 6-bit pattern of 32x32 dyes covering a 15x15 mm^2 area. The layout of the Location Finder cell is shown in Fig. 1. Each cell contains two sets of six lines oriented in X- and Y- direction, respectively and is separated from the neighboring cells by a reference line. The FESEM image of a cell is processed using Radon transform [2] to find the position of the bit lines. The location of the reference line provides position of the cell with respect to the edges of the calibration pattern. The SEM image displacement caused by the sample bias is measured by moving the sample diagonally in X- and Y- direction and imaging the sample with and without bias. The images are processed in-line to provide the dependence of the image shift vs stage position.

RESULTS AND CONCLUSIONS

Figure 2 shows a typical dependence of the image stage Y-coordinate. The displacement of the image is approximated by a linear fit (Fig. 2) and its coefficients are used to calculate and adjust the stage position for the biased sample [1]. The standard deviation of the location measurements in repetitive experiments is ~0.15 um. The linear approximation of the experimental dependencies adds on average ~20 um error into blind navigation in biased sample.

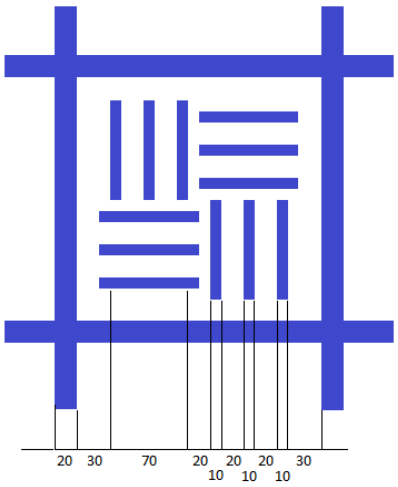

Figure1. Layout of Location Finder cell.

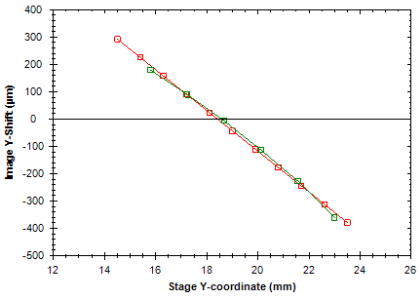

Figure 2. Image displacement as a function of the stage position in Y direction. Green – experiment, red – linear fit.

References

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