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Dear Marty

This is the 9th bimonthly report detailing work done on Contract N00014-89-C-2238 during April and May 1991.

3.31 Advanced Column Development

Progress on the advanced column continued in the areas of imaging, spot size measurements, and solving a high voltage problem. We imaged an X-ray mask with the column to verify image parameters such as dose and dwell time to successfully image a mask without damage. We produced images of both 0.5 um features and associated clear and opaque defects with less than the maximum acceptable dose. The maximum acceptable dose is one that will produce images with minimmal channeling and ion-induced sputtering.

We automated spot size algorithm measurements using error function analysis and routinely measure spot sizes 5-10 nm greater than predicted. These are measured using a single isotope ^{69}Ga ion source which improved spot sizes by 5 nm.

We have completed the proof of concept (POC)test column, on schedule, and began testing the production prototype column. This latter column did not change significantly from the POC column. All major components stayed the same. Minor changes were made to the octopole mounting and drift tube, and Micrion designed a 50kV feedthrough to correct an arcing problem associated with high voltage components. It will include a revised aperture selection mechanism which is being developed. This production column will go on the 0.25 um repair system in the latter part of 1991.

3.32 Repairs

We are investigativing deposition of alternative absorbers for clear defect repair. The ideal material will have a deposition yield greater than 6 in order to sufficiently minimize undesirable deposition on adjacent vertical sidewalls during the deposition process. We recently deposited gold from dimethyl gold hexafluoroacetylacetonate with yields of 4 - 10. We tested the opacity of FIB deposited gold by exposing a series of depositions on an X-ray mask to Hampshire Series 5000 X-ray Stepper™. Gold depositions as thick as or thicker than 2000 Angstroms transferred into both positive and negative resists. We plan to investigate other materials as well.

Part of the experimentation showed that we will have to scan the beam faster than our current electronic are capable of to avoid gas depletion during the deposition process. The electronics being developed for 0.25 um mask repair will allow us to scan the beam faster than 0.2 um per pixel.

A number of real defects on a 0.5 um X-ray mask were repaired by manually placing the repairs. We will examine them in the field emission SEM that we acquired for placement accuracy, and we are currently beginning a statistical study of automated edgefinding analysis.

Micrion is successfully receiving KLA defect data and we are testing the loop by repairing the defects we find. IBM will then expose the repaired mask, and KLA will reinspect it.

3.33 System Stability

There has been less emphasis on this area recently. We fabricated test fixtures for temperature measurement and installed them in the interior of the mask repair system in order to study the effect of internal system temperature on longterm drift. This study will begin this summer.

3.34 Software

We are currently receiving KLA data transfer information, but remaining issues include location of a common reference mark, transfer of common image format data, and a field of view(need to agree on the accuracy of defect location data).

A new software and computer architecture has been evaluated and selected for 0.25 um repair, and will be retrofitted at some time on the existing 0.5 um machine. It is UNIX based, providing for ethernet capability, significant image processing techniques, and uses the X window graphical user interface. This framework will allow us to achieve the advanced scanning strategies and faster scanning speeds needed for repairing 0.25 um geometries, and will allow for significantly improved imaging.

We plan to incorporate both the new electronics and software into a system in late 1991.

3.35 Electronics

A new electronics package was evaluated and developed for 0.25 um mask repair. It is capable of advanced image processing, faster beam deflection speeds, and will provide for the ability to do multi-step repairs in one automated sequence. Part of the motivation for selection of the hardware was the obsolescence of electronics components.

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During the next quarter we plan to focus on the production prototype column, compiling statistical data on the resolution capability of the current mask repair system, and completing the 0.25 um electronics and software subsystems.

Sincerely

Diane K Stewart

Diane K. Stewart
X-ray Program Manager

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