Characterization of the Heidelberg MLA 150

CNF Summer Student: Jason Xu
Student Affiliation:

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Mentor(s): Giovanni Sartorello , Cornell NanoScale Science and Technology Facility, Cornell University

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Contact: tjp83@cornell.edu, jasonxu810@gmail.com

Research Group Website: https://www.nordtechub.org

Primary CNF Tools Used: AJA Q, AJA Q2, Filmetrics R50, FleXus Film Stress Measurement, Hamatech Hot Piranha, P-7 Profilometer, Veeco Icon AFM

Abstract:

This research on the Heidelberg MLA 150 focuses on three key areas to optimize its performance: Dose and Defocus Tests, Alignment Tests, and Resist Characterization. The Dose and Defocus Tests aim to identify the ideal energy (dose) and laser optics position (defocus) for machine operation, with particular emphasis on regularly monitoring and correcting defocus drift caused by software malfunctions or stage crashes. Alignment Tests verify the functionality of the machine's internal alignment system by assessing the precision with which the laser writes complimentary patterns based on camera-read substrate patterns. Any misalignments are quantified, and correction factors are calculated. Finally, Resist Characterization involves empirically determining optimal exposure doses for various resists, populating a database that future users can access for efficient and accurate material processing.

Summary of Research:

My research on the Heidelberg MLA 150 has been focused around three main tests/areas: Dose and Defocus Tests, Alignment Test, and Resist Characterization. The purpose of Dose and Defocus Tests is to determine the optimal Dose and Defocus for the machine to operate. Dose is a measure of the nominal energy used to expose the substrate, while defocus is a measure of the position of the machine's laser optics. We can determine the most optimal combination of dose and defocus by exposing test patterns at various dose and defocuses and reading the resolutions of the tests. Attention is focused on the Defocus, as it is much more likely to drift due to software malfunctions and stage crashes. As a result of these crashes, Dose and Defocus Tests must be carried out regularly to ensure that the optimal dose and defocus values are known. The purpose of Alignment Tests is to ensure that the alignment system within the machine is working properly, by loading a substrate that contains patterns spread around that may be read by a camera within the machine. The camera sends the information to the alignment system, which relays to the laser where it believes the substrate and staging is, which then writes a complimentary pattern to the original pattern on the substrate. We read how well the two patterns fit together, which tells us whether the alignment system is working properly [2]. Oftentimes, the alignment is not perfect, and we are able to calculate a correction factor to input into the machine by reading the offsets of the patterns. The rest of the time on the Heidelberg MLA 150 was spent on Resist Characterization. By testing a large range of doses on various resists, we were able to determine the optimal doses for many resists that we add to a database that future users may access and quickly determine the optimal dose to expose at.

Conclusions and Future Steps:

Dose and Defocus Tests and Alignment Tests must be regularly conducted due to stage crashes and other natural shifts. These ensure that users are always exposing at the most optimal dose and defocus and that the alignment system is working properly. Besides these tests, the database for Resist Characterization may always be added upon, and future time should be spent characterizing a larger selection of resists.

Acknowledgements:

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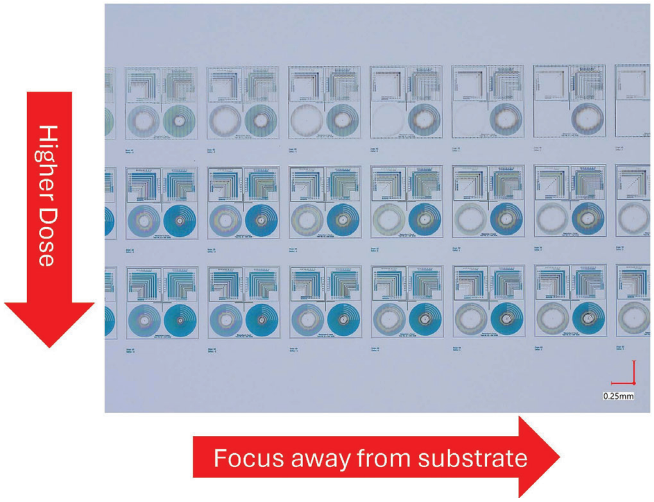

Figure 1: Dose and Defocus Test on a Wafer Coated in S1805.

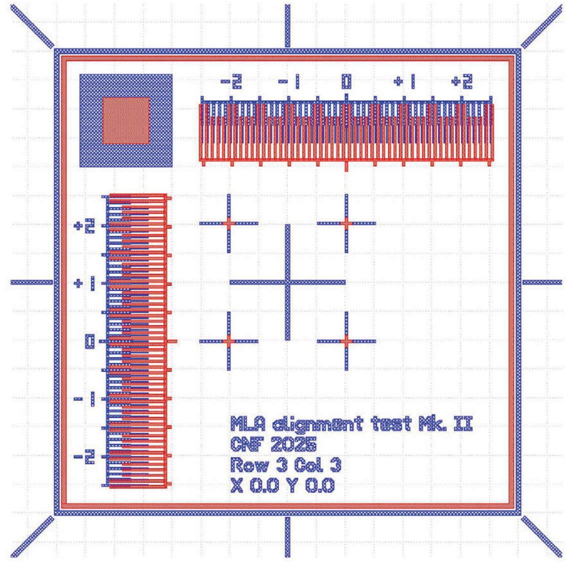

Figure 2: Alignment Test gds File.