Impact of New MoSi Mask Compositions on Processing and Repair

Anthony Garetto[1], John Stuckey[2], Don Butler[2]
[1]Carl Zeiss SMS, 1 Corporation Way, 01960 Peabody, MA
[2]MP Mask Technology Center LLC, 8000 S. Federal Way, Boise, ID 83707

ABSTRACT

The mask industry has recently witnessed an increasing number of new MoSi mask blank materials which are quickly replacing the older materials as the standard in high end mask shops. These new materials, including OMOG (opaque MoSi on glass) and A202, are driven foremost by the need to reduce feature size. The extension of 193 nm exposure to the 32 nm node has been accomplished through the use of aggressive optical proximity correction (OPC) which, due to intricate features and complex patterns, makes defect inspection and pattern transfer, cleaning and repair difficult.

In order to address the increasing difficulty in inspection that is brought about by this ever increasing feature complexity, much attention has been given to the use of OMOG which, due to it's binary nature, demonstrates many advantages over 6% attenuated MoSi such as improved resolution and CD uniformity and an improvement in the inspectability [1,2].

Another MoSi material of interest, A202, is a high transmission (20%) material which also attempts to address the challenges presented by transitioning to smaller technology nodes. This material utilizes a thinner overall substrate stack than previous high transmission schemes allowing the resolution of smaller features and more robustness for cleaning steps. This material also eliminates process steps which leads to an increase in CD uniformity across the mask and translates to savings in time and money.

While both these materials are MoSi based materials their small compositional changes require, in some cases, a significant change in processing. Among the most impacted areas are the etch, clean and repair steps. Given the potential for defects to manifest on masks, repair is an invaluable step that can significantly impact the overall yield and lead to a reduction in cycle time [3]. The Carl Zeiss MeRiT® electron beam mask repair line provides the most advanced repair capabilities allowing a wide range of repairs to be performed on a number of mask types [4].

In a joint effort between MP Mask Technology Center LLC and Carl Zeiss SMS, this paper focuses on the benefits of the new A202 mask blank and the challenges it presents to the repair community. On site compositional surface and depth analysis was performed with a XPS on an A202 mask blank and traditional A61A in order to compare the compositional differences. Monte Carlo simulations were performed to elucidate the differences in beam interaction volume. After defining these initial differences, development of a new repair process for A202 utilizing the on-site Carl Zeiss MeRiT® MG 45 is presented along with several repairs and their AIMS™ results.

REFERENCES

1. T. Faure et al., “Characterization of Binary and Attenuated Phase Shift Mask Blanks for 32nm Mask Fabrication”, Proc. SPIE Vol. 7122, pp. 712209, (2008).
2. K. Badger et al., “Impact of the OMOG Substrate on 32 nm Mask OPC Inspectability, Defect Sensitivity and Mask Design Rule Restrictions”, Proc. SPIE Vol. 7122, pp. 71220A, (2008).
3. A. Garetto, J. Oster, M. Waiblinger, and K. Edinger, “Challenging defect repair techniques for maximizing mask repair yield”, Proc. SPIE Vol. 7488, pp. 74880H, (2009).
4. A. Garetto, C. Baur, J. Oster, M. Waiblinger, and K. Edinger, “Advanced process capabilities for electron beam based photomask repair in a production environment”, Proc. SPIE Vol. 7122, pp. 71221K, (2008).