Deep-UV-Lithography: Principles, Optimization, and Simulation

Keil, Matthias; Møller, Niels Peder; Khomtchenko, Elena; Johansen, Leif Steen

Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Deep-UV -Lithography: Principles, Optimization, and Simulation

Matthias Keil*1, Niels Peder Møller1, Elena Khomtchenko1, Leif Steen Johansen1
1: DTU Danchip, Ørsteds Plads, Building 347, 2800 Kgs. Lyngby

*Corresponding author email: makei@danchip.dtu.dk

One of the key issues for lithographic optimization is the definition of metrics needed to classify the process quality. This quality can be improved by the modification of relevant optical parameters, as e.g. the wavelength, the numerical aperture and the coherence of the aerial image. Additionally, the impact of the reaction kinetics of the resist during exposure, post exposure bake and development must be considered in order to exceed the requirements of the device to be fabricated.

An overview of improvement techniques of deep-UV lithography processes will be presented that will gain insight into its fundamental principles required to characterize and to optimize the optical and chemical process. A combination of two different approaches has been investigated, assisted by simulation calculations with the help of the Prolith™ software from KLA-Tencor. In the first approach the focus-exposure matrix is used to determine a process window that leads to a maximized depth of focus for the required specification, as i.e. the target CD, the exposure latitude, the resist loss and/or the side-wall angles. Figure 1 shows the focus-exposure matrix of a hole-array, including the relevant information obtained by a simulation, i.e. the isofocal point, the target CD, the resist bias and the isofocal bias). Secondly, with the help of the gradient-based approach, the gradients of the image that is projected and recorded into the photoresist can be used as a metric for both the achieved image and resist contrast (not shown here).

Fig. 1: Focus exposure matrix (Bossung curves) for a hole-array (200nm linewidth, 500nm pitch)