A new concept and some results of an ion beam deposition process for EUV mask blanks

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We present a new concept for ion beam deposition and the corresponding deposition equipment. The new concept was designed for the deposition of Mo/Si multilayer stacks, which are intended to be used as mask blank mirrors in the next generation lithography (EUV-lithography). Besides the high reflectivity at a wavelength of 13.4 nm, it is of special importance to avoid particle generation in the PVD deposition process. The new deposition concept will allow to grow a multilayer stack consisting of 50 Mo/Si-pairs of about 7 nm period within 40 - 50 minutes.
A linear ECR ion source with a segmented grid system control is introduced as the key feature of the new concept. This ECR ion source allows to adjust the beam profile, whereupon a minimization of the substrate motion without loss of layer homogeneity and thickness stability is obtained. In order to minimize particle generation a special substrate motion and transfer system is designed and demonstrated within the above addressed ion source and motion concept. Furthermore, a rotating target drum construction with 16 single targets will be discussed with respect to the new concept and layer quality demands.
In-situ deposition process control is proposed for the optimization of the deposition time of the Mo/Si multilayer stacks. We will demonstrate spectroscopic ellipsometry as a successful candidate for in-situ process control. First experimental results of reflectivity measurements at X-ray (Cu-Kα) and EUV (13.4 nm) wavelength, transmission electron microscopy (TEM) and atomic force microscopy (AFM) measurements are presented and discussed for EUV-multilayer stacks.

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