Design and Characterization of a Low Defect Density Mo/Si Deposition System for the Fabrication of EUVL Reticle Blanks

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Reticles for extreme ultraviolet lithography (EUVL) consist of a high reflectance multilayer (ML) coated substrate (the reticle blank) that is overcoated with a patterned absorber layer to form a reflective mask. Any reflectance variation in the reticle constitutes a potential reticle defect. At present there are no strategies for repairing defective regions of the ML coating. Consequently there is considerable interest in developing a deposition technology capable of producing virtually defect free high reflectance Mo/Si MLs. Specifications for the reticle blank require a defect density of less than 0.06/cm2 at 0.05 mm diameter or greater over reticle dimensions of 13x22 cm at a magnification M=1/51. In many respects, reticle fabrication requires merging highly developed, disparate technologies - the fabrication of a high reflectance low defect density ML optical coating to standards normally associated with semiconductor manufacture.

The design and characterization of a low defect density Mo/Si ML deposition system commissioned specifically for EUVL reticle blank fabrication is reported. A filamentless, inductively coupled, low frequency rf ion source with focusing optics2 is used to sequentially sputter elemental Mo and Si targets to form the ML. Ar is used as the sputtering gas. System features include fully load-locked operation, single wafer transfer from cassette to the deposition chamber and standard mechanical interface (SMIF) handling of the cassette. Sample introduction and transfer occurs in a class 1 minienvironment. 150 mm diameter Si wafers are employed as substrates, a concession to the ready availability of appropriately clean substrates and compatibility with standard semiconductor diagnostic tools. Defect characterization is undertaken with a Surfscan 6420 which can detect 0.13mm diameter particulates on the ML coated wafer surface at greater than 90% efficiency3. This instrument is also configured for SMIF handling of cassettes and is housed in its own class 1 minienvironment, adjacent to the deposition system.

1 The National Technology Roadmap for Semiconductors, Semiconductor Industry Association (1994).

2 Veeco Instruments RIM 210 ion source

3 Tencor Instruments, Santa Clara, Ca