DESIGN OF VACUUM MECHATRONICS FOR THE ASML EUV ALPHA DEMO TOOL

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Within the semiconductor industry Extreme Ultra Violet Lithography (EUVL) is considered as the most likely successor of 193nm immersion lithography. This new technology offers solutions for volume manufacturing at the 32nm technology node and beyond. However the transition to EUVL has a significant impact on the design, realization and operation of the lithography tools. Besides the increased positioning accuracy and stability of optics and stages (sub-nm) required for 32nm and beyond lithography, the system has to be compatible with the high vacuum requirements of the EUV technology. These high vacuum requirements are driven by the absorption of EUV photons in air, and the reflection loss of the optics, that arises from contaminants in the vacuum system in combination with EUV radiation. With respect to current lithography tools this requires in many cases redesign of current hardware (e.g. sensor systems should be made vacuum compatible) and in some cases even new concepts (e.g. stage configurations).

Within the ASML EUVL program, Philips Applied Technologies (Apptech) has been involved in the overall system design of ASML's EUV alpha demo tool. Philips Apptech and ASML have co-developed several modules of this tool: wafer stage, reticle stage, wafer handler, metrology frame (including the vibration isolation system), main chamber, and vacuum system.

To meet the vacuum requirements, the outgassing within the vacuum system should be strongly limited and sufficient pumping capacity should be available. Therefore the amount of materials within the vacuum chamber should be minimised whereas the outgassing rate of the applied materials should be very low. Furthermore the vacuum components should have a very high level of cleanliness.

By applying new bearing and actuation configurations in the stage design, the amount of components within vacuum can be minimised since a relative large part of the actuation system is located outside the high vacuum environment. All components within the vacuum are designed to be cleaned relatively easily, and are preferably bakeable to remove all contaminants.

Since EUVL most likely will be applied for the 32nm technology node and beyond, the positioning requirements of stages and other modules are higher than for current lithography tools. The waferstage requires a scanning accuracy of 1 nm at a scan velocity of 0.25 m/s. Since reflective optics are used in any EUVL system as compared to refractive elements in state-of-the-art lithography, the stability of the optical elements with respect to each other should be >10 times better. This asks for new concepts in the design of the projection optics module and in the vibration isolation system. Therefore a new vacuum compatible vibration isolation system has been developed with a significantly better isolation efficiency than current systems.

ASML's first EUV AD tool has been fully integrated and is currently being tested and qualified. Before integration, all modules were qualified successfully with respect to functional- and vacuum performance.

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