NANO PATTERNING STEPPER FOR IMPRINT LITHOGRAPHY

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Nano Imprint Lithography is recognized as a cost-effective technique for replication of devices of micro or nanometer scale. A step and repeat approach applied to Nano Imprinting Lithography and showing sub-50nm imprint resolution with sub-micrometer overlay accuracy is presented. Breaking up the full field into smaller individual patterning fields that are addressed one after each other reduces significantly the impact of the run out. It also cuts dramatically the cost for the template which is of much smaller dimensions. The presented Nano Patterning Stepper demonstrates high resolution imprinting and high accuracy overlay in both Hot Embossing and Cold Embossing (UV-NIL) techniques. Applications include integrated optical devices, smart materials for microelectronics, sensors for temperature, light, molecules, life science, 3-dimensional replication…

For high mechanical stability an air bearing stage is used on a solid granite frame. The template is first pre-leveled. During the following high-precision step a 10 nm parallelism is achieved across a 50 mm field. Inter-substrate autoalignment achieves submicron accuracy with its Cognex-based pattern recognition system. A pressurized stamp holder is used for non-flat substrates. Actually, the leveling and pressuring systems used are based on proven mask aligner technology that is in successful use since three decades.

Both Hot and Cold Embossing techniques can be used on the novel imprint tool. Hot Embossing can be performed with temperatures up to 450°. There are independent temperature controlled systems for the template and for the wafer. And only the area under the stamp is heated up to a temperature which is a little bit lower than the glass transition temperature of the resist. This technology is necessary to avoid degrading to already imprinted structures during the sequentially performed imprinting. The print head is thermally insulated from the rest of the mechanics. The minimum leveling force is 5 N and can be increased to 4000 N. The movement of the imprinting head can be controlled by the position or by the force.

The UV curing tool for cold embossing uses LED arrays with a well defined wavelength of 375 nm. This method is maintenance-free and needs no warming-up phase. The minimum embossing force in this case is again 5 N and can be increased to 100N.

First high resolution pattern generation with quartz and silicon stamps have shown 50 nm capability.