Reinhard Voelkel

SUSS MicroOptics SA
CH-2068 Hauterive, Neuchatel
Switzerland

reinhard.voelkel@suss.com

ABSTRACT

Imprint lithography allows manufacturing thousands of refractive microlenses, microlens arrays, diffractive optical elements (DOE), gratings, beam-splitters, phase plates (free-form) and other planar Photonics components on one wafer. Wafer-stacking allows manufacturing complex systems or modules in parallel. The presentation will provide an overview of the status of wafer level imprint technology and gives an outlook of future technology developments in the field of imprint lithography for wafer level optics (WLO) applications and processes. The presentation also gives a perspective of the critical importance of optical system design, mastering, stamp manufacturing, process industrialization, wafer stacking, wafer-level packaging (WLP), metrology and inspection when manufacturing Photonics components.

IMPRINT LITHOGRAPHY AND WAFER STACKING

Wafer-based manufacturing technology was introduced by Semiconductor industry in the 1960s and is one of the most impressive success stories of mankind. Wafer-based manufacturing technologies is also used to manufacture micro-optical components. Micro- and nano-structuring technologies like direct-writing, photolithography, wet- or dry-etching, laser-ablation, polymer-on-glass imprint or ion-diffusion processes can be used to manufacture refractive or diffractive micro-optics.

For mass-production at low costs the most suitable manufacturing technology is imprint lithography. Here a soft stamp is filled with a monomer or polymer that is cured by UV light during the imprinting process (Fig. 1). The imprint could be done by a step & repeat process [1] or full wafer imprint [2]. Today, imprint lithography is used in industry e.g. for manufacturing of miniaturized sensors and structured light sources in smart phones, for bio-chips, for automotive lighting and other applications. Imprinted microlens wafers are stacked in a mask aligner (Fig. 2) and diced to individual optical modules (Fig. 4).

Reference:

[1] H. Schmitt, M. Rommel, A.J. Bauer, L. Frey, A. Bich, M. Eisner, R. Voelkel, M. Hornung, “Full Wafer Microlens Replication by UV Imprint Lithography“, MNE 2009, Ghent, Belgium.

[2] R. Voelkel, J. Duparre, F. Wippermann, P. Dannberg, A. Braeuer, R. Zoberbier, S. Hansen, R. Suess, „Technology trends of microlens imprint lithography and wafer level cameras (WLC)”, 14th Micro-optics conference (MOC, 08), 25.–27.9.2008, Brussels, Belgium (2008).

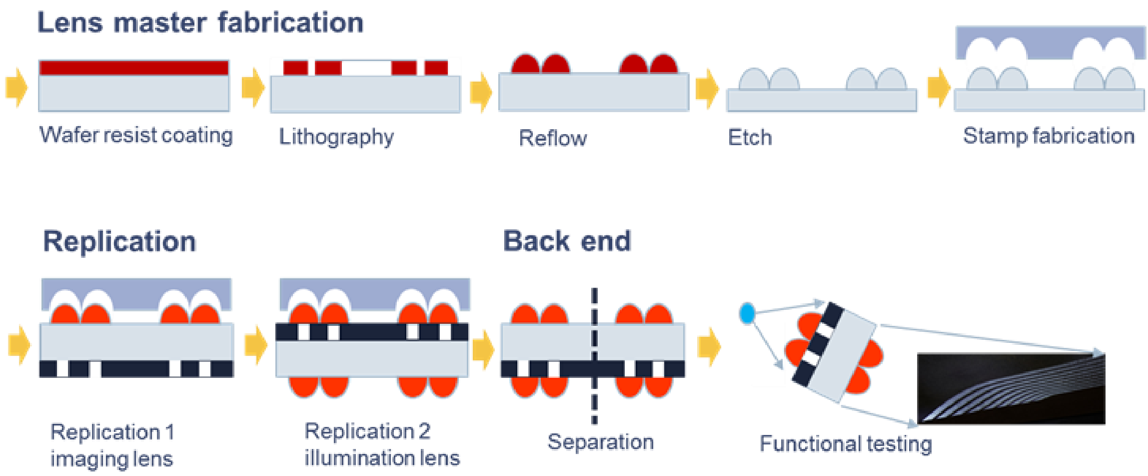

Figure 1. Process flow for imprint lithography at the example of double-sided microlens array as used for automotive lighting (light carpet)

Figure 2. Mask aligner (Suss MicroTec) for imprint lithography and wafer stacking

Figure 3. Microlens wafer in cleanroom

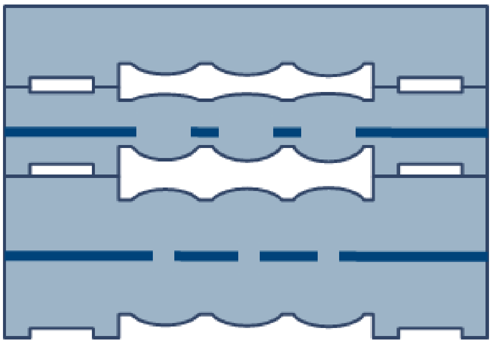

Figure 4. Stack of different microlens arrays and buried aperture layers as used for light carpets or car head lights

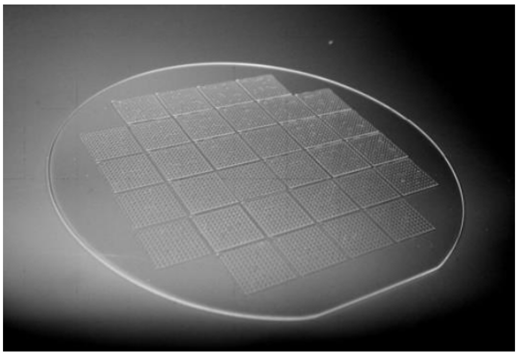

Figure 5. Microlens wafer made by step & repeat imprint lithography [1]