

Driving The Industrialisation Of Nanoimprint Lithography

by Pier Costa

New consumer electronic products such as cameras, mobile phones, palmtops, flat screen TVs and next generation optical storage media like HD-DVD and Blu-ray require better performance, additional functions, smaller sizes and lower prices. The demand from the manufacturers is for cost-efficient production tools that deliver high precision and superior quality. Nanoimprint Lithography (NIL) is an emerging technology that can provide all this. And, in fact, many global players within the semiconductor and electronics industry have been evaluating NIL for some time now. Recently, a Swedish nanotechnology leader has brought Nanoimprint Lithography one step closer to mainstream adoption by unveiling what it calls the first NIL machine for high volume manufacturing. We take a look at this machine and the prospects for NIL in electronics manufacturing.

For some years now Nanoimprint Lithography has been considered a promising candidate for large-scale production of nanometre-sized structures, offering high speeds and unbeatable resolution. The technology, which is used to replicate high precision micro- and nano-structures onto a substrate, has been shown capable of imprinting sub-10nm structures in an R&D environment. In addition to ongoing research on the technology, NIL has also entered the commercial development stage, where it is being evaluated by numerous electronics manufacturers for use in production. Recently however, the technology has reached significant milestones that indicate it is now ready for the next step: industrialisation and broad adoption across a series of specific sectors of

electronics manufacturing. In fact, in 2006 Korea-based Samsung released the first mass-produced consumer electronics product containing a component manufactured with NIL. Furthermore, on 30 January of this year at a launch ceremony in Malmö, Sweden, the first NIL machine designed to meet the requirements for volume production was officially unveiled: Ob-



Figure 1 - Control panel of the HVM Nanoimprint Lithography system

Figure 2 - Patrick Lundström, CEO of Obducat, with Toshiaki Mogi, assistant manager of Canon Marketing Japan, at Obducat's headquarters in Malmö, Sweden during the presentation of the HVM NIL machine on 30 Jan. 2007



ducat, a global leader in Nanoimprint Lithography equipment and processes, presented their High Volume Manufacturing (HVM) NIL system, featuring a throughput of 90 wafers per hour and cassette to cassette handling of up to 8-inch diameter substrates. The machine is designed for full area imprinting using the company's intermediate polymer stamp (IPS) process, which lowers the risk of substrate contamination by replicating the master stamp on an intermediate polymer film, which is used once for imprinting and then discarded.

Traditional lithography vs. NIL

Nanoimprint Lithography is a competitive alternative to UV and x-ray lithography especially in terms of total cost of ownership. Furthermore it is well-suited to large area imprinting, making it convenient

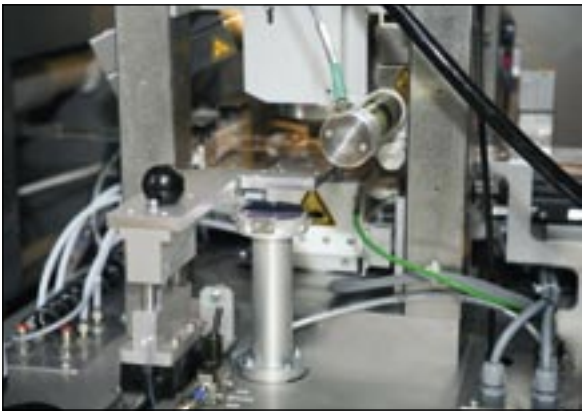


Figure 3 - Close up of the substrate handling area



Figure 4 - An imprinted 2-inch wafer

for products such as flat screen displays. In the effort to drive the adoption of NIL, Obducat is focusing on applications where the technology brings high added value to its clients. "Simple" applications can help customers become acquainted and confident with the technology, enabling them to subsequently implement it in more demanding applications. Obducat also plans to create development consortiums together with customers in order to support the overall development task. In the flat screen display industry, for instance, the challenge of developing both the NIL solution and the entire process flow is very complex: it will require considerable time and effort and is best faced through a strong collaboration between equipment supplier and electronics manufacturer.

NIL for opto-electronics

According to Obducat, NIL has the potential to bring significant added value to customers in several areas of electronics manufacturing. The opto-electronics sector represents

the early adopter of the technology, with volume production of the first NIL-manufactured component (an opto-electronic device) beginning in 2006. This sector includes products such as portable large screens and optics for optical media players and data communication systems. Components produced include camera filters, polarisers, microlenses and image sensors. Industrialisation of NIL in this sector will continue throughout 2007 with many products expected to hit the market in 2008.

Magnetic and optical storage

Obducat expects to see industrialisation of NIL-based manufacturing processes begin in two more sectors this year: magnetic storage media and optical storage devices. In the hard drive area, multimedia applications are driving growth, but there is a need for higher density. As the industry moves towards Discrete Track Recording (DTR) and subsequently 3D patterned media, Obducat believes NIL will come into play for track and 3D bit isolation.

As far as optical storage is concerned, with the launch of HD-DVD and Blu-Ray with their 25 GB of storage capacity, the entertainment industry will be able to put a two-hour movie for HDTV on one disk. However, this represents the lower limit of what is acceptable to the industry,

which needs a solution to increase storage capacity rather urgently. A likely route for expanding disk capacity is the dual layer disk, which calls for a cost efficient manufacturing solution not currently available. Obducat sees in this a good opportunity for NIL, which may find use as a technique for patterning optical media and focusing light in disk players. For these sectors, mass produced consumer products containing components manufactured with NIL are expected to reach the market in 2009.

Flat screen TVs and HDI

Looking further ahead, flat screen displays and High Density Interconnect (HDI) applications are seen as the likely candidates for the subsequent wave of NIL industrialisation. Flat screen displays are facing continued growth. However, for this growth rate to be sustainable, manufacturing costs must be reduced and yields improved. This is where Obducat sees an opportunity for NIL, in particular for the manufacture of films, large area imprints and glass panels. This same opportunity for NIL exists also in the area of HDI printed circuit boards for mobile phones, palmtops, digital cameras and other portable electronic devices, where in addition functionality must also be increased.

Obducat estimates a total potential capital expenditure for Nanoimprint Lithography systems across all sectors of 950 million euro for the timeframe from 2007 to 2011.

Figure 5 - Obducat's new HVM NIL machine

