Experiment name: LADRUM

Experiment "motto":

Manufacturing of seamless large area hierarchical patterned surfaces on a cylindrical mold by a two-step ultrashort pulse laser writing and utilization these within a roll-to-roll ultraviolet nanoimprint lithography (R2R-UVNIL) process.

The Business Sector

Laser-based engraving for R2R-UVNIL manufacturing of textured functional films has presented a vast interest for various business sectors such as automotive, solar -cells, buildings, medial and consumer goods. Production of functional surfaces with tailored properties such as self-cleaning, anti-microbial, hydrophobic/-philic and anti-reflective increase the efficiency and add value to the standard products.

The Company

Nanotypos is an SME that concentrates on developing, producing, and marketing patterned surfaces by means of nanoimprint and roll-to-roll nanoimprint lithography techniques. Nanotypos produces and distributes client-specific, patterned films including security holograms, photonic/optical components, decorative films with haptic effects, and provides micro/nano manufacturing services for multidiscipline market sectors.

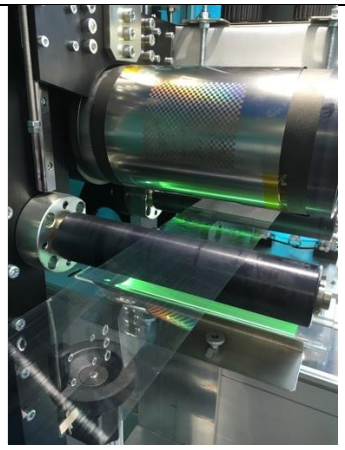

Figure 1 Image of patterned cylindrical mould containing nanoscale diffraction patterns

The Challenge

The main challenge in roll-to-roll nanoimprint production is the access to seamless cylindrical moulds suitable to function as working moulds for our continuous lithography process. Moreover, the generation of multilevel micro/nano topographies on non-planar surface (drum mould surface) in a fast, inexpensive and precise manner is a pre-request for advance manufacturing.

The solution

The usage of novel ultrashort pulse laser sources with high power in combination with fast scanning technology have been utilised throughout our experiments for direct texture writing into metal. We developed micro-processing approaches able to transfer on cylindrical drum-mould patterns with curved topography for continuous embossing of UV curable resist materials. The Nickel drum mould has been treated and engraved with high precision in one machining tool providing different laser machining wavelength, beam splitting and accurat scanning tools to avoid discontinuous boundary issues and low thermal impact.

The Benefits

The main benefit in our manufacturing approach is the time and cost reduction in combination to the discontinuous fabrication of large area patterned films. The access to advanced laser facilities with capabilities of processing with two different laser sources allowing the generation of hierarchical topographies while the high precision of the scanning source allows us to generate seamless large area patterned films. Unlike the classical microelectronics manufacturing approach, where a number of lithography and electroplating steps are needed with our approach only one step if needed for generating our working moulds. This manufacturing approach decreases the overall delivery time and results in a supply of cost effective large are functional films.

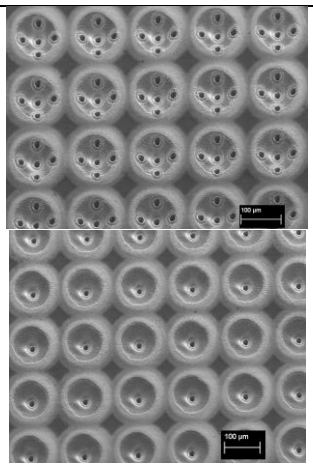

Figure 2: Top view scanning electron microscope images of Nickel mould patterned using the two-step ultrashort laser pulse writing set-up.

The Team

The **Leibniz Institute of Surface Modification (IOM)** is a centre for application-oriented research and development; its focus is on the materials processing of surfaces and thin films by non-thermal methods induced by beam technologies.

The **SCANLAB AG (SCANLAB)** – since its founding in 1990 – has successfully focused on developing and manufacturing galvanometer scanners and scan solutions. Its products turn lasers into highly dynamic and flexible tools for materials processing.

The Team Benefits

During the LADRUM experiment all team players benefited from the development of the complete manufacturing chain addressed to realise micro structured films and demo products. The integration into an existing roll-to-roll nanoimprint lithography line, the micro-textured drum achieved by ultra-short laser engraving, together with the fast scanning capabilities delivering tailored hierarchical features allowed us to demonstrate the feasibility of manufacturing chain. Moreover, our team benefited knowhow from the generation of un-conventional structures with high precision laser micro-processing for niche application applicability.

LADRUM

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KEYWORDS:

Roll-to-Roll Nanoimprint Lithography, Ultrashort laser processing, Large Area Functional Surfaces, Hierarchical Patterning,