Laser Interference Lithography for Nanostructured Surfaces

Regina Luttge, Henk van Wolferen and Leon Abelmann

MESA[+] Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede; The Netherlands

Email: r.luttge@utwente.nl
Homepage: http://www.el.utwente.nl/smi/

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Objective

The objective is fabrication of arrayed sub-100nm nanopatterns and study of their interactions with biological material (tissue, blood, viruses, proteins etc.). These nanostructured surfaces can by exploited as interfaces for biological and chemical sensor systems.

Methods

Laser interference lithography (LIL) operating a 266nm continuous laser source is utilized for pattern generation. Standard (100) prime silicon wafers were used. For LIL, we employ diluted Olin 907-13 and chemical amplified resist (CAR) being suitable to spin-coat a film thickness below 200nm. Both resist systems allow us to fabricate gratings, dots and even complex grayscale lithographic patterns at high resolution.

Results

We employed up to four multiple exposures with the photoresist subsequently being developed in a single step to generate *Moire*-type nanopatterns. Simpler nanograting and nanodot arrays were also fabricated to explore their surface behavior. Lithographic results and evaluation of droplet shape are depicted in Figure 1 below.

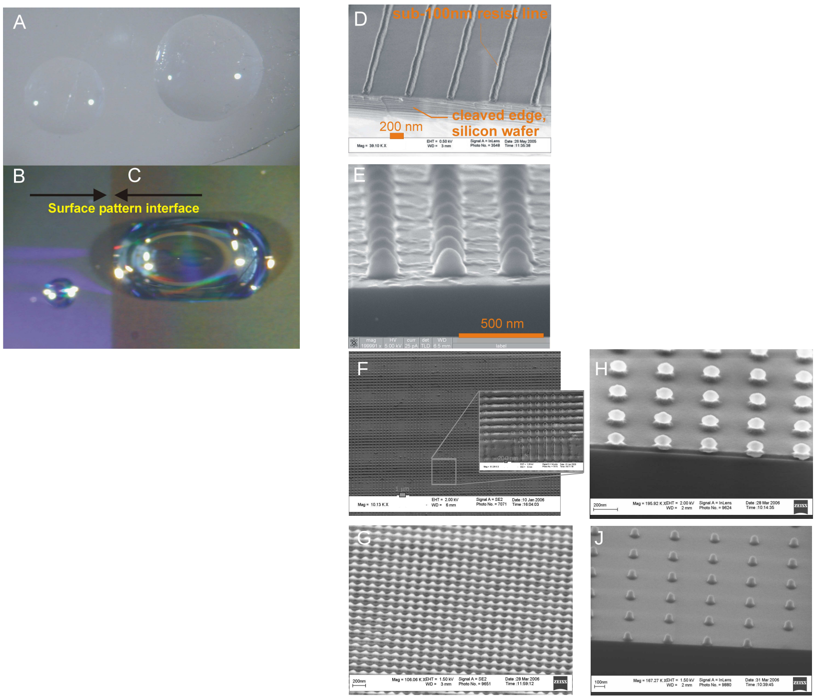

Figure 1. Lithographic results and evaluation of droplet shape

(A) µl-sized water droplets on unpatterned glass. (B,C) µl-sized water droplets on LIL surfaces showing the ability to influence the shape of a droplet by the geometry of the nanostructure. Spreading of the larger droplet in (C) stops at the interface between two different patterns. (D) Typical LIL grating structure in resist. (E) Double exposure leading to dome shaped dots. (F) Four multiple exposures resulting in a spatially defined 3-D nanoarray throughout the exposure area of 2cm x 2cm using Olin. (G) 3-D nanostructure using CAR at a period of 150nm. (H) Double exposure using CAR leading to 3-D nanopattern in resist. (J) Same pattern as (H) after O_2 plasma etching.

Conclusions

Two and three dimensional periodic surface patterns at the nanoscale can be generated employing 266nm-laser interference lithography. The photoresist material can be used to explore physical effects at nanofluidic interfaces as well as molecular biointeractions.

References

R. Murillo *et al.*, Microelectronic Engineering, 2005, **78-79**, 260-265.