



Contribution ID: 123

Type: Invited Technical Oral Communication

Proton Beam Writing applications into DNA nano fluidics

Thursday, 10 July 2014 10:30 (30 minutes)

Proton beam writing (PBW) is an ideal technique to fabricate lab-on-chip devices with features down to the nano scale. PBW exhibits low proximity effects coupled with the straight trajectory and even energy deposition its path will results in sidewall smoothness of a few nm RMS. The high penetration depth of the proton beam enables the production of high aspect ratio, high density 3D nano structures with smooth sidewalls, ideal for high quality mold production for nano-imprint-lithography (NIL) applications. In PBW experiments proton beams can now be focused down to $13 \times 29 \text{ nm}^2$, revolutionizing applications of MeV proton beams [1] e.g. high aspect ratio lithography down to 19 nm in HSQ.

HSQ, PMMA and SU-8 are all suitable resist material for PBW with a high resolution and smooth sidewall [2]. The comparison of these three photoresist under the same fabrication condition has never been done. Here we will compare the resolution of these three different resist at sub 100 nm level with the optimized proton dose and the same beam size.

The improved PBW performance opens up new ways of mold production for NIL applications. Using HSQ resist as a mold material an easy method is introduced allowing fast replication of complicated nanofluidic lab on chip devices featuring cross-sections down to 60 nm in polydimethylsiloxane (PDMS). These HSQ molds can be used more than 200 times to replicate nanofluidic devices capable of handling single DNA molecules [3]. A novel mold design will be presented which allows the manipulation of DNA molecules inside PDMS nanochannels as well as large scale DNA genome mapping.

PDMS replication is not compatible with sub 50 nm lab on chip fabrication. To achieve polymer nanofluidic circuits down to 19 nm, PBW fabricated resist structures will be replicated in OrmoStamp™ (Micro Resist Technology GmbH) to form hard stamps which can be used in thermal NIL. In our experiments, different types of resist will be tested on the compatibility with Ormostamp replication. Initial test with Ormostamp molds are used in NIL.

References

- 1 JA van Kan, P Malar, and AB de Vera, Rev. Sci Instrum 83, 02B902 (2012)
- 2 JA van Kan, AA Bettiol and F Watt, Nano Letters 6 (2006) 579
- 3 JA van Kan, C. Zhang, P. Malar and J.R.C. van der Maarel, Biomicrofluidics 6 (2012) 036502-1

Primary author: Prof. VAN KAN, Jeroen Anton (CIBA, Department of Physics, National University of Singapore, Singapore)

Co-authors: Mr LIU, Fan (CIBA, Department of Physics, National University of Singapore, Singapore); Mr YAO, Yong (CIBA, Department of Physics, National University of Singapore, Singapore)

Presenter: Prof. VAN KAN, Jeroen Anton (CIBA, Department of Physics, National University of Singapore, Singapore)

Session Classification: Session 7 - 5th Proton Beam Writing Workshop