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High aspect ratio 3D nanopatterning using Proton Beam Writing[1]

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Proton beam writing (PBW) is a new direct write lithography using MeV protons, and is unique because of its ability to fabricate 3D structures of high aspect ratio structures directly in resist material like PMMA, SU-8 and HSQ. The introduction by CIBA, Singapore of a dedicated PBW facility, capable of writing at the micro- and nano- scale has facilitated high aspect ratio nanostructuring. PBW has demontrated high aspect ratio walls in HSQ down to the 20nm level. In recent experiments details down to sub 20 nm have been achieved in PMMA. Monte-Carlo calculations have shown that structuring down to the nanometer level is feasible. All this is possible because of the virtual absence of proximity effects (unwanted resist exposure by stray secondary electrons). The design and performance of this unique nanoprobe facility will be discussed. Two potential fields of application (eg nanofluidics and nanowire integration) of PBW will be discussed. Currently nanofluidics devices have typically only **one** critical dimension below 100 nm. Here we will introduce PBW as a powerful technique to fabricate molds for replication of PDMS nanofluidic circuits down to the sub 100 nm level in **two** dimensions. Initial chips with dimension down to 150 nm have successfully been used to study DNA folding in quasi-1d nanochannels in tandem with fluorescence imaging. Since the size of these PDMS nanochannels is not limited by the PDMS or PBW further miniaturization down to the sub 100 nm level is a realistic goal and initial results will be discussed. Nanowires are a potential building block for nano-electronic devices, and one critical problem is the integration of nanowires to form contacts. Porous alumina templates and high energy ion-tracks have been used for the production of nanowire templates in a random orientation. Since PBW is the only true 3D direct write nanolithographic technique it can be used to fabricate nanowire templates in a controlled manner.

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