Embedded SiO2 nanosheets in PDMS using an alternative nanopatterning process.

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Micro-nano patterned poly(dimethylsiloxane) (PDMS) is a common material used in fabricating microfluidic devices, cell culture, lab-on-chip devices, micro-contact printing stamps, nanoimprint lithography mold, or phase shift lithography … Functionnal PDMS surface has been demonstrated by controlling the structured PDMS surface energy by wet and/or dry techniques, leading to new applications like locally metal transfer from PDMS stamp to a substrate, locally adhesion of biomolecules on treated PDMS substrates and so on.

We propose a versatile way for rending the PDMS more funtionnal by embedding nanosheets of material on its surface (Fig.1). As an example, vertical nanosheets of SiO2 (Fig.2) have been enbedded into the conventional PDMS surface (Fig.3).

Nanosheets of several millimeter in length are obtained with using conventional microtechnologies. The nanosheet width is defined during the oxidation of the silicon substrate, typically 200nm in this example (Fig.2).

On this principle, many kind of materials can be embedded into the PDMS surface, like metal, insulator or semicondutor based nanosheets since these materials can be deposited onto the SiO2 nanosheet (between step d) and e) in Fig.1). Embedded nanosheets in PDMS can be chemically etched to make nanochannels or nanocavities in PDMS on large area with high density.

This simple method which does not need any e-beam lithography or high cost equipments, is simple, cost effective and suitable for making fast prototype. Therefore this unconventional process for embedding nanosheets in PDMS can lead to new applications in photonics, biology, micro-nano fluidics …

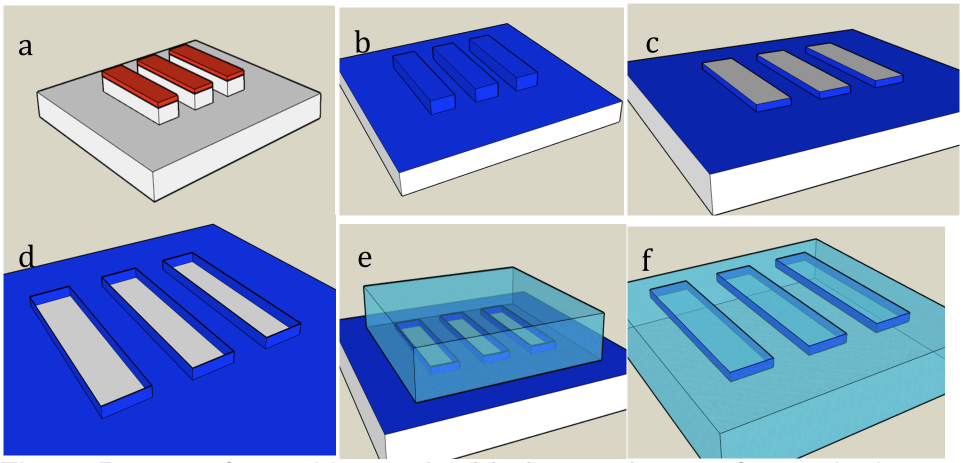

Fig.1 : Process for making embedded nanosheets of material into a PDMS layer. a) photolithography and DRIE (3min) on a silicon substrate, b) oxidation, c) Chemical Mechanical Planarization to remove SiO2 on top of the patterns, d) DRIE (3min) to define SiO2 nanosheets (vertical sidewalls of the patterns), e) PDMS molding, f) Releasing of SiO2 nanosheets when peel-back of the PDMS

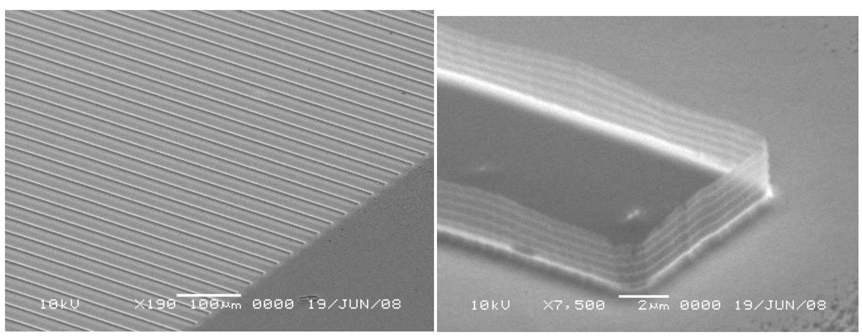

Fig. 2: Scanning electron microscope (SEM) top view of the high density SiO2 nanosheets on a silicon substrate (corresponding to Fig1. d).

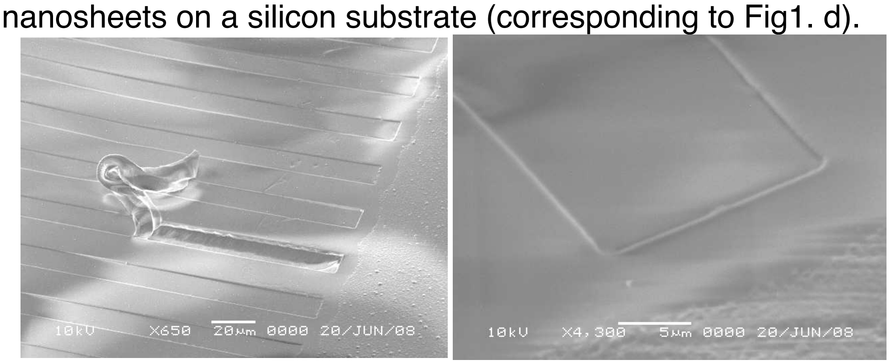

Fig. 3: SEM top view of the PDMS layer with embedded SiO2 nanosheets after peel-back from the silicon substrate.