High performance DLC-based mold technology with high control over micro and nano features for optics and microfluidics

1 ADAMA Innovations Limited, The Naughton Building, Trinity College Dublin, Dublin 2, Ireland
2 Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) and School of Physics, Trinity College Dublin, Dublin 2, Ireland

E-mail: daniela.angione@adamainnovations.comt

Polymeric materials having engineered micro or nanoscale features are required in a number of application fields such as, health care, optoelectronics, space science, clean energy, etc. Among the different polymer processing techniques used for reproducing those nano-features with an high control over size and shape, micro-injection molding represents the most appealing one, due to its low cost, mass production capabilities, easy of automation and possibility of replicating at the same time bulk and surface features [1].

In addition, nanostructured surfaces with high aspect ratio (higher than 1:1) are becoming very popular for their application in antireflection coating, cell culturing and differentiation, super hydrophobic bio-surfaces. In this context, microinjection molding would be the ideal manufacturing route for obtaining high precision and high volume production of those nanofeatures.

In this work, an experimental study of the replication of sub-micron periodic features by injection molding is presented. Micromachining, combined with DLC coating and subsequent nanostructuring (technology patented by ADAMA) allowed to create steel inserts which can be used for replication of thousands to hundreds of thousands of polymer parts with functional nanofeatures [2,3]. This technology allows to shorten the development time of replication molds with functional surfaces.

Inserts produced with this approach were used to produce surfaces with wettability control, enhanced capillarity, cell fixing and filtering abilities, all produced as passive components fully produced in a single polymer part.

The technology is also been applied for the realization of optical quality grating to be implemented in high precision linear optical encoders. The impact of the technology developed at ADAMA, in fundamentally enabling a rapid prototype mold fabrication, will drive disruptive innovation in several application fields ranging from medical devices to microfluidics to optics.

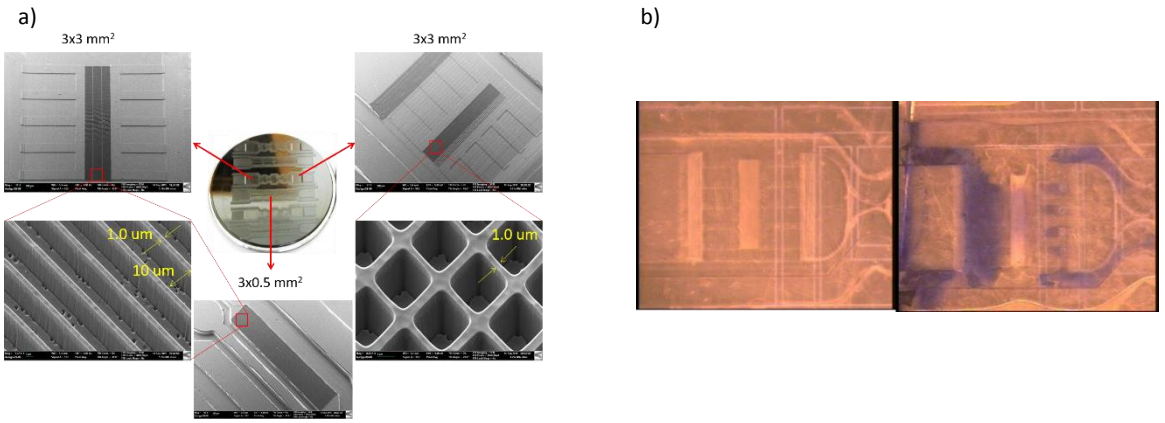

Figure 1: SEM images (Figure a) of the final pattern realise for the microfluidic chip (showed in the middle). Figure 1b shows the microfluidic chip before and after being filled with whole blood.

References

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