

Double-anchoring fluorinated molecules for anti-adhesion mold treatment in UV nanoimprint lithography

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Nanoimprint lithography (NIL) is one of the most promising new technologies for fabricating patterns with high resolution at a high throughput and reasonable cost. One of the key challenges in NIL is to prevent resist adhesion to the template surface. Different strategies may be adopted for this goal, such as adding surfactant to the resist formulation and or treating the template surface. In this last case, fluorinated monolayers grafted on the template surface are interesting because of their performances and ease of (re)deposition, but these layers suffers a premature degradation after repeated imprints. In a recent work, we have demonstrated using Electron Spin Resonance (ESR) that this degradation is mostly due to a chemical interaction between the resist free radicals and the fluorinated molecules covalently bonded onto the quartz surface.¹ Furthermore, we showed that the degradation strongly depends on the resist free radical nature. However, it is not clear where the fluorinated molecules are attacked by the free radicals (on the fluorinated chain or on the grafting end) and if the conformation of the molecule plays a role in this degradation. To try to answer to these questions, we compare two different perfluoropolyether molecules having either one (Optool DSX from Daikin Chemical) or two (FLUOROLINK® S10 PFPE from Solvay Solexis) silane grafting end groups.

Both molecules are grafted on a quartz template in liquid phase through their methoxy- or ethoxy-silane end groups. They are then tested on an EVG step and repeat UV-NIL equipment using a particularly aggressive acrylate-based resists; the antisticking properties and chemical structure are investigated using water contact angle, X-ray Photoelectron Spectroscopy (XPS) and ESR measurements.

Even if an Optool DSX newly treated template presents a slightly higher water contact angle in comparison with FLUOROLINK® S10 PFPE, this is no more the case after a few imprints (Fig. 1). XPS analysis confirms the better resistance of the double anchoring molecule (Figure 2 and Table 1). The reason of the better stability of FLUOROLINK® might be a better anchoring, a lower chemical reactivity and or a higher mechanical strength. To find the accurate answers to these questions, detailed ESR experiments are under progress.

¹ D. Truffier-Boutry et al. *Chemical degradation of fluorinated anti-sticking treatments in UV nanoimprint lithography*, to appear in Applied Physics Letters (2009)

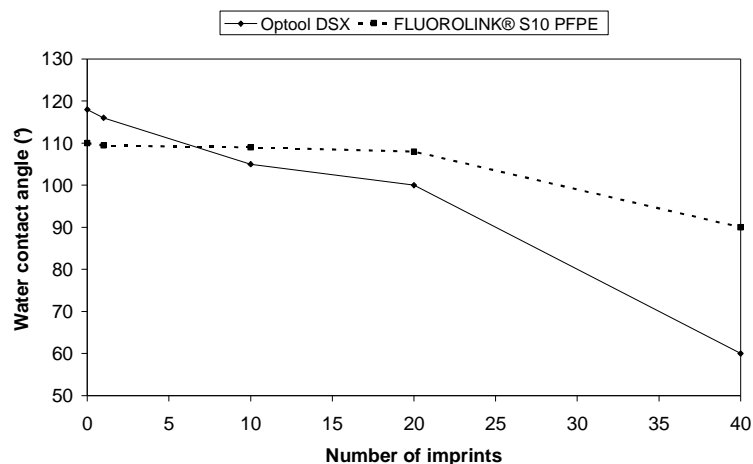


Fig. 1: Water contact angle on silica templates treated with Optool DSX and FLUOROLINK® S10 PFPE when newly treated and after several imprints.

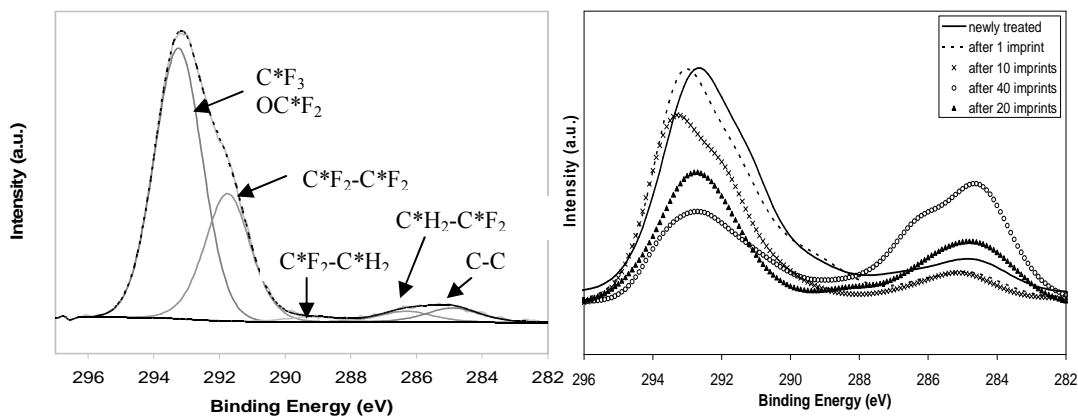


Fig. 2: C1s XPS spectra of Optool DSX newly treated stamp (left) and of FLUOROLINK® S10 PFPE treated stamp (right, newly treated and after several imprints). Different contributions of the chemical bonds of the molecules can be identified and followed during the imprinting process.

Number of imprints	0	1	10	40
Optool DSX	52	48	40	-
FLUOROLINK® S10 PFPE	46	45	45	22

Table 1: Remaining Fluorine (%) at the stamp silica surface measured by XPS at the beginning and after several imprints for Optool DSX and FLUOROLINK® S10 PFPE.