Ultra-Thin F-DLC Coating for Nanoimprint Lithography Imprinters

Ryan W. Fillman and Robert R. Krchnavek
Rowan University, 201 Mullica Hill Rd., Glassboro, NJ 08028

Nanoimprint lithography (NIL) has proven to be an exceptional lithographic technique for achieving arbitrary, nanoscale features, over large areas, without the use of costly step-and-repeat UV lithography tools. One requirement for NIL is to eliminate adhesion of the imprinted polymer to the imprinter upon withdrawal of the imprinter. Several methods to reduce adhesion have been published [1, 2]. Of particular interest is the plasma deposition of a layer of fluorinated diamond-like carbon (F-DLC). F-DLC is used as a NIL imprinter coating to provide a durable anti-wear, anti-stick layer. Previous work [3, 4] has shown that DLC is a tough coating with a low surface energy (~ 40 mJ/m^2). The fluorinated self-assembled monolayer on top of the DLC lowers the surface energy further (~ 20 mJ/m^2) while retaining the strength properties of the DLC. In these previous studies, the DLC was either thick (>100 nm) or was the entire substrate. In this work, we show that the advantages of F-DLC can be obtained using standard processing of SiO_2 on Si imprinters with subsequent deposition of F-DLC. The anti-stick layer is minimal in thickness (~2nm) and retains the properties of both the DLC and the low surface energy of the fluorinated layer. The advantage of this technique is that it does not require thick DLC layers or entire substrates of DLC. Furthermore, it should be applicable to a wide range of imprinter materials.

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[4] M. Schvartzman, A. Mathur, Y. Kang, C. Jahnes, J. Hone, and S. J. Wind, J. Vac. Sci. Ttechnol. B **26** 2394 (2008).

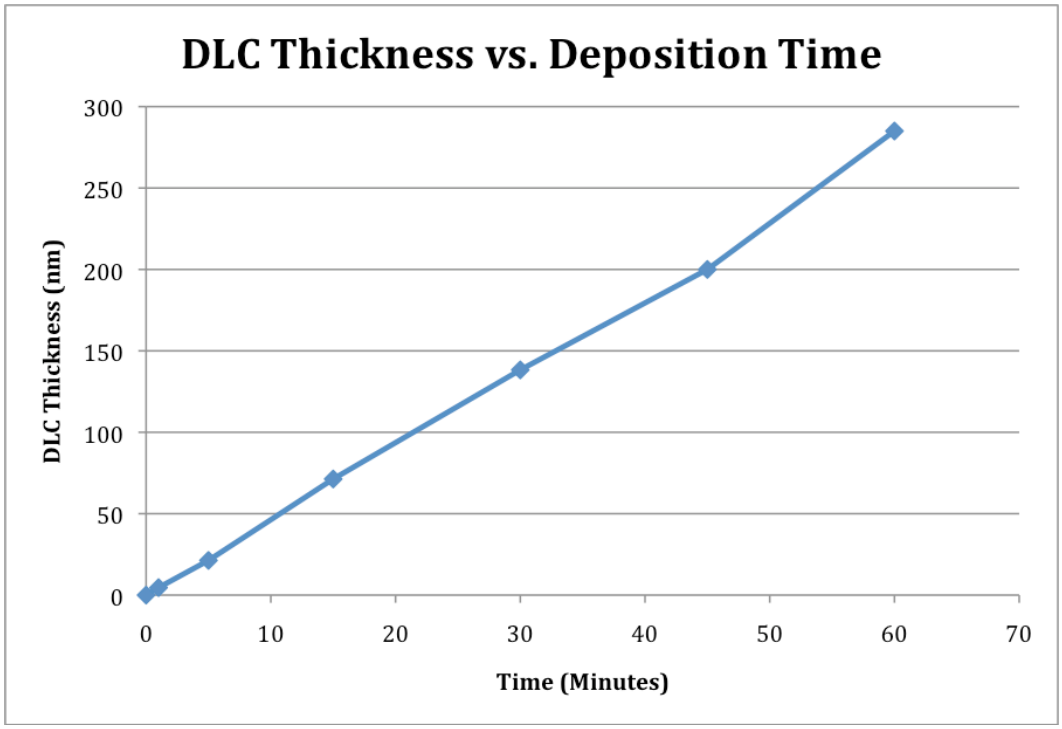

Figure 1: DLC thickness plotted versus rate with an average rate of 4.6nm/min

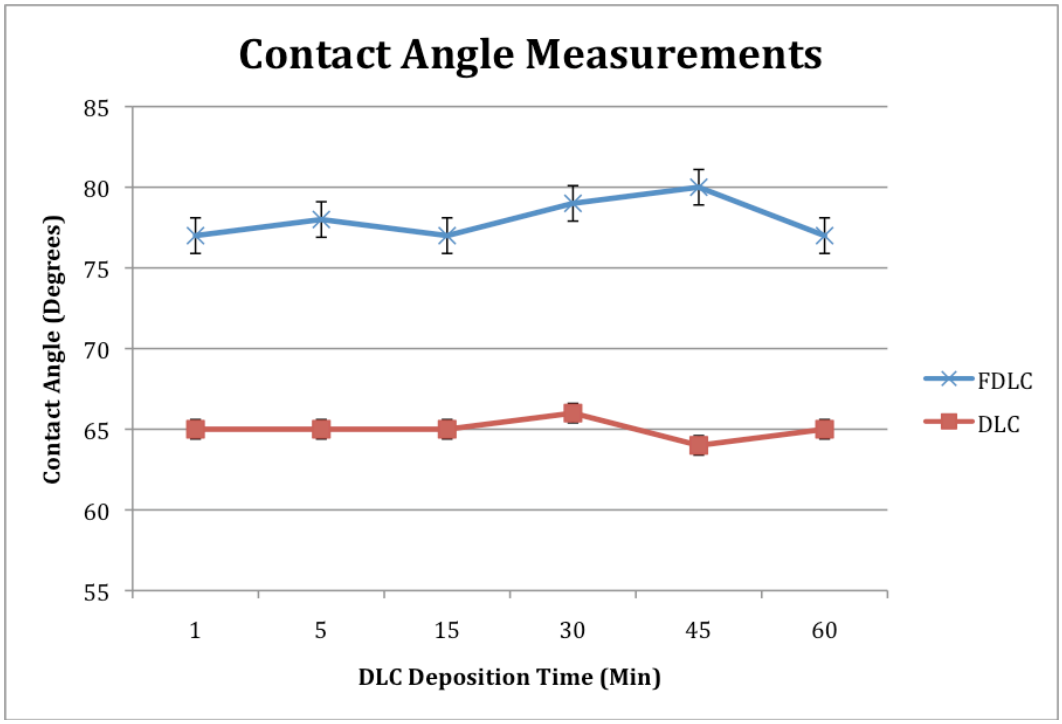

Figure 2: Contact angle measurements for both DLC and FDLC layers in degrees