Inkjet-printing of working stamp materials for UV-based nanoimprint lithography

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The large area stitch free step-and-repeat fabrication of working stamps for UV nanoimprint lithography (UV-NIL) is an interesting and challenging topic. The possibility to use smaller stamps and stitch them together to obtain a larger stamp is interesting, especially in the context of roller-based nanoimprint lithography. We want to use UV-curable materials as stamp materials. As deposition process for the UV-curable stamp materials we investigated inkjet-printing. Inkjet printing has several advantages as compare to other methods like spin coating, droplet dispensing, doctor-blading: most notably the possibility to locally control precisely the amount of material and to deposit the resist only on specific parts of the substrate are interesting. However inkjet printing also has very strict requirements as far as viscosity and other material properties are concerned. Commercially available UV-curable stamp materials are not suited for inkjet printing as they are. Therefore we modified materials like OrmoStamp [1][2] to make them suited for printing in our Dimatix Inkjet printer. We used conventional diluents as well as reactive diluents (see figures 1, 2 and 3). Standard solvents have the advantage that they do not change the chemistry of the material, while reactive diluents do not have to be evaporated before patterning. After inkjet printing the materials were used in an UV-NIL process to fabricate a working stamp. These stamps were then again used in a UV-NIL process (see figure 4) to investigate the suitability of the modified materials for the use as stamps for UV-based nanoimprint lithography.

In this paper we demonstrate the possibility to modify commercial nanoimprint working stamp materials to enable their inkjet-printability. We also show that this inkjet-printable resist materials can still be used as working stamp materials for UV-NIL.

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References
Figure 1. Optical photograph of inkjet printed Ormostamp diluted with a standard solvent. The width of the image is 1.62mm.

Figure 2. Optical photograph of inkjet printed Ormostamp diluted with a reactive diluent. The width of the image is 1.62mm.

Figure 3. Temperature-dependent viscosity of different Ormostamp variants (RD stands for Reactive Diluent, D for Diluent)

Figure 4. Comparison of Profilometer Measurement: top line: master, middle line: with reactive diluents, bottom line: with conventional solvent. The height difference can clearly be seen showing the need to evaporate the solvent before imprinting.