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Compound fabrication for in-liquid selective Self-Assembly

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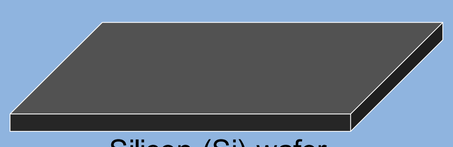
LMIS1

Abstract

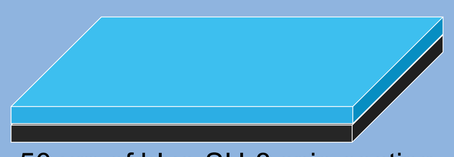
Passing from millimeter to micrometer scale, the traditional pick and place method for assembling large amount of compounds becomes difficult and time consuming. At micrometer scale it is then very important to have other assembling methods. This work presents the ability to perform selective and pairwise serial self-assembly of more than 500 immersed compounds, using hydrophobic interaction [1]. To show the selectivity of the assembly, bicolor 100 µm SU-8 filled cylinders have been fabricated by photolithography techniques. Inducing selective hydrophilic interaction, a yield higher than 60% of correctly assembled parts has been achieved.

Fabrication

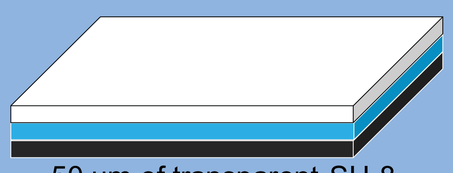
Bicolor filled cylinder prototyping



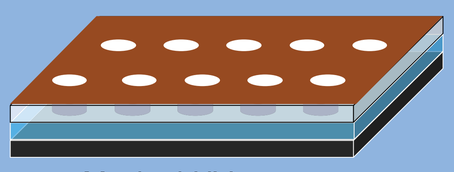
Silicon (Si) wafer



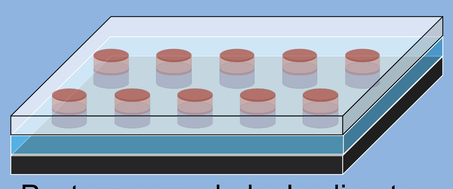
50 µm of blue SU-8 spin-coating



50 µm of transparent SU-8 spin-coating

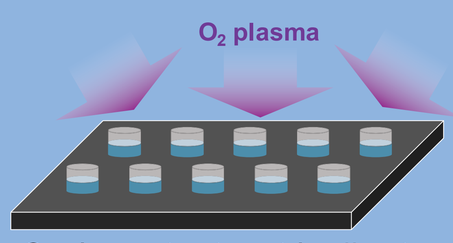


Masked UV exposure

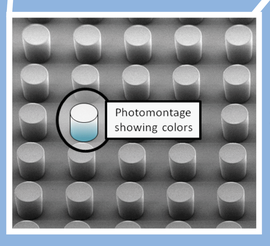


Post exposure bake leading to ploymerized cylindrical shapes

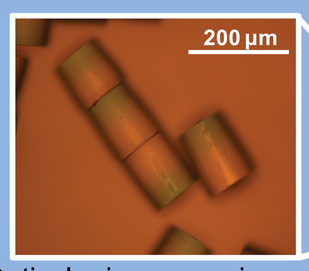
SU-8 development and hard bake



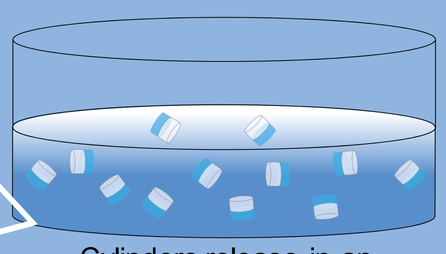
O_2 plasma treatment leading to hydrophilic SU-8 surfaces



SEM image of SU-8 cylinders before release



Optical microscope image of SU-8 cylinders after release

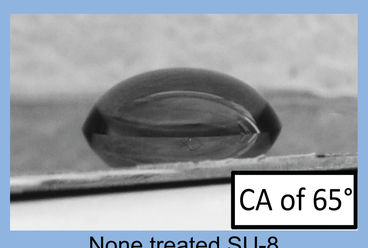


Cylinders release in an ultrasonic bath

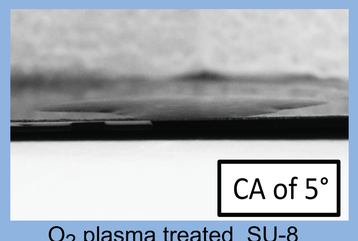
Contact angle measurements

H_2O drop on SU-8 surface contact angle measurements (CA):

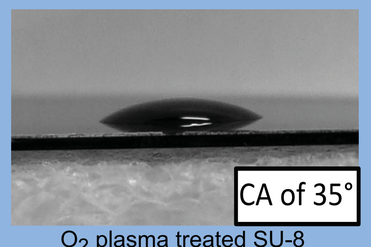
The hydrophilic behavior of O_2 treated SU-8, influencing its surface energy, will decrease over days [2].



None treated SU-8



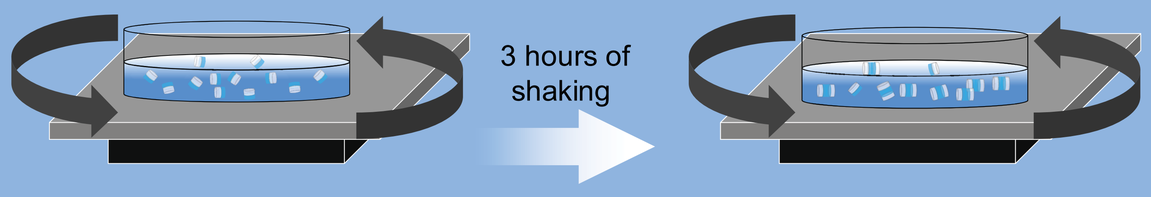
O_2 plasma treated SU-8 directly after



O_2 plasma treated SU-8 after 2 days

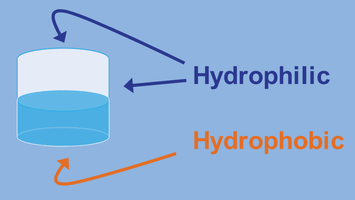
Self-Assembly (SA)

Experimental setup

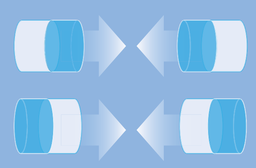


Orbital shaking of the compounds in DI water

Selective and pairwise SA

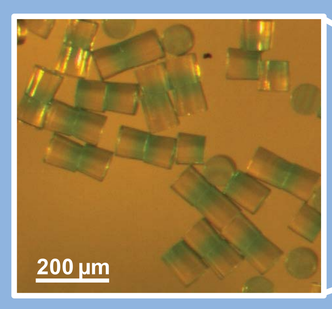


- Induced hydrophilic behavior
- Natural hydrophobic behavior

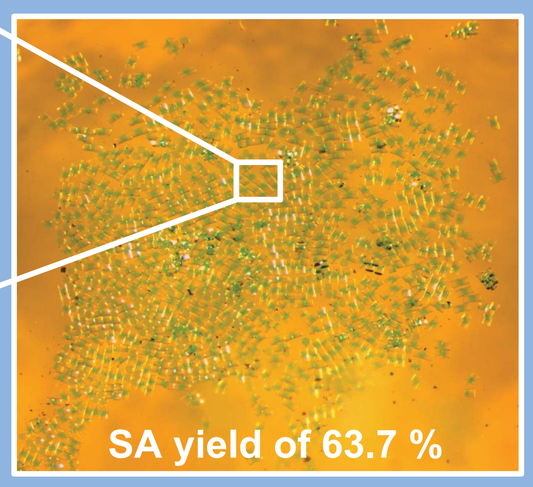


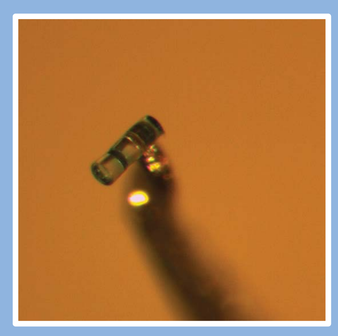
- Orbital shaking
- Compounds can interact

- Most stable configuration



SA yield (correctly assembled compound number / total number of compounds) of 63.7 % counted over 794 compounds





After evaporation, compounds are kept together by stiction forces

Conclusion

We showed the fabrication of bicolor SU-8 filled cylinders. Using the natural hydrophobic SU-8 tendency and an O_2 plasma to selectively functionalize the cylinder surfaces, we performed in liquid SA. With an optimized orbital shaking, we obtained a selective and pairwise SA yield above 60%, shown by the two colors of the cylinders.

Acknowledgements

We would like to sincerly thank Dr. S. Jiguet from Gersteltec who provided us the colored SU-8. We also thank the CMi from EPFL for the fabrication and the DISAL for the nice collaboration. This work has been done in the framework of SelfSys, scientifically evaluated by SNSF as well as financed by the Swiss Confederation and funded by Nano-Tera.ch.

References

[1] M.R. Gullo, L. Jacot-Descombes, L. Aeschimann and J. Brugger (2011) Mater. Res. Soc. Symp. Proc.Vol. 1299

[2] F. Walther, P. Davydovskaya, S. Zürcher, M. Kaiser, H. Herberg, A.M. Gigler and R.W. Stark (2007) J. Micromech. Microeng. 17 524–531