

Self-Assembling of Particle Monolayers by Spin-Coating

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INTRODUCTION: Monodispers particles dried from suspension form domains of highly ordered hexagonal arrays.¹ The self-assembly of such particle monolayers can be achieved for example by controlled drying² and spin-coating.¹ The presented work is a study on self-assembling micron-sized particle monolayers by spin-coating. The motivation for engagement with this matter has the final goal of creating biologically relevant patterns. The use of ordered particle monolayer arrays as etching masks is considered to be a fast and cheap alternative to classic photolithographic patterning techniques which allows for the creation of nanopatterned features with separations in the micron-range. Especially biologically oriented research has a high sample consumption (e.g. cell studies) therefore cheap patterning techniques are highly relevant.

METHODS: 2 μm polystyrene particles were dispersed in a solution of methanol and surfactant Triton[®] X-100.¹ A standard spin-coater was used to coat the dispersion onto glass and titanium dioxide substrates. The influence on the monolayer formation was investigated as a function of particle and surfactant concentrations of the coating fluid and of the spinning speed (100 to 6000 rpm). The particle concentrations were varied between 1:3 to 1:100 (v/v). The surfactant concentrations were varied between 1:30 and 1:400 (v/v).

RESULTS: The sizes of the monolayer areas and of the perfectly ordered domains therein were highly affected by the spinning speed and composition of the coating fluid. By adjusting these two parameters monolayers were successfully produced. The main problem interrupting particle self-assembly was the insufficient adhesion between the suspension and the substrate materials. We were able to solve this problem by adding the appropriate surfactant concentration for different spinning speeds. The influence of the surfactant as a bonding agent to support monolayer formation was investigated and showed substantial differences between the different concentrations. In the end large area monolayers formation was achieved (Figure 1) and will be presented in the poster.

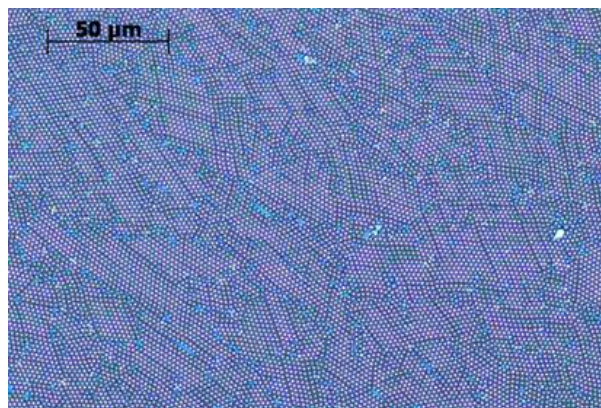


Fig. 1: Light microscopy image of hexagonal ordered domains in a polystyrene particle monolayer on a glass substrate. Such ordered monolayers were achieved with the following spin-coating settings: particle concentration, 1:100; surfactant concentration, 1:200; spinning speed, 200 rpm

DISCUSSION & CONCLUSIONS: We showed that monolayer formation by particle spin-coating is possible even there were some reproducibility problems. The interactions between the suspension and the substrate material and the influence of the surfactant as a bonding agent were substantial and need to be further investigated. The presented particle domains and monolayer areas are already large enough to serve as etching masks which will allow for the creation of biologically relevant patterns.

REFERENCES: ¹P. Jiang et al. (2004) *J. Am. Chem. Soc.* **126**: 13778-13786. ²N.D. Denkov et al. (1992) *Langmuir* **8**: 3183-3190.

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