# Investigation of the surface properties of SU-8 for biological Applications

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**INTRODUCTION:** Micrometer structures for fluidic systems are often manufactured in polymers like SU-8 or PDMS. Bioactivity is strongly influenced by the surface properties. Thus, controlling the surface free energy (SE) and the wetting behaviour of the system is crucial [1]. To render polymeric surfaces hydrophilic an $O_2$ plasma treatment is commonly employed [2]. While previous reports [3,4] focus on the effect of various gases on several polymers such as PMMA and polystyrene we are interested in the $O_2$ Plasma treated SU-8. Especially the evolution of the SE over time due to ageing effects is important for the calculation of the usability in bio-MEMS applications. To elucidate this processes we carried out contact angle goniometry over time. Topographic imaging by AFM allowed the quantification of changes of the surface roughness induced by the plasma process.

**METHODS:** Samples were prepared by a conventional spin coating process of SU-8 on 4" Si wafer according to the fabrication instructions of the manufacturer (microchem), including a hardbake process. $O_2$ Plasma activation has been accomplished at 150W and 13,56MHz. Measuring the contact angle with a DSA10 goniometer from Krüss allowed the determination of the SE over several weeks.

The surface topology was imaged by an AFM from Veeco (Dimension IV) in tapping mode.

**RESULTS:** The AFM measurements on the surfaces showed a drastic increase of the surface roughness by the plasma treatment. Granular nano-aggregates developed with a size depending on the treatment time.

The effect of plasma treatment can be clearly seen by comparing AFM images of a SU-8 surface before and after plasma treatment (figure 1).

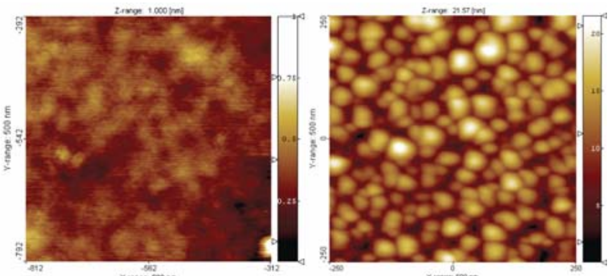

*Fig. 1: Topography of SU-8 measured by AFM. (a) before exposure (b) after 120 s $O_2$ plasma.*

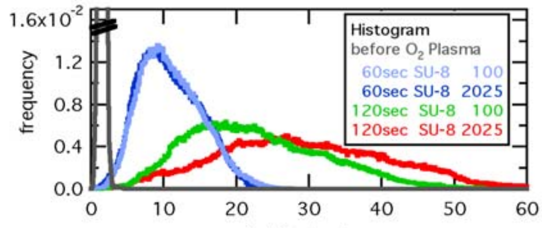


*Fig. 2: Height distribution over plasma duration*

The surface roughening is illustrated by the analysis of the height histogram (figure 2). Evaluating the maxima in the histogram, a change from 1 nm (before treatment) most frequently populated height to 10 nm (60 s plasma) and 20 nm (120 s plasma) is evident. For 8 min exposure the aggregates grow to 120nm.

The observation of the contact angle over several weeks indicated that after the $O_2$ plasma activation the hydrophobicity recovered within several days.

The initial SE after plasma activation (80 mN/m) decreased simultaneous to the hydrophobic recovery to 50 mN/m.

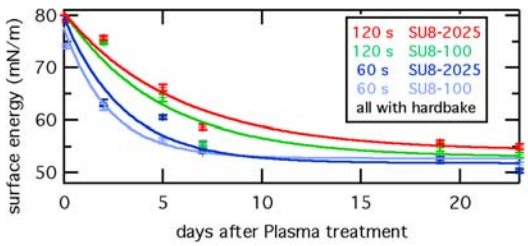


*Fig. 3: Surface energy development for 60 s and 120 s plasma duration and different PR solvents.*

**DISCUSSION & CONCLUSIONS:**

$O_2$ Plasma treated surfaces of SU-8 keep their ultra-hydrophilic properties and high surface energy typically for less than one week. Longer plasma treatment results in a drastically increase of the surface roughness, but the high SE lasts longer. Due to the fact that the bioactivity a.e. of artificial cellular systems depends on the surface energy, constant conditions have to be arranged. For long-term experiments the change in SE has to be considered.

**REFERENCES:** [1]M. Nordström et al. J. Michromech. Microeng 14 (2004), [2]J. Chai et al. Langmuir 20 (2004), [3]D. Hegemann et al. Nucl. Instr. Meth. Phys. Res. B 208 (2003) [4]A. Oláh et al. Appl. Surf. Sci. 239 (2005)