NANO- DEPTH CONTROL OVER SELF ASSEMBLED STRUCTURES ON BIO-COMPATIBLE POLYMERIC THIN FILMS FOR BIO-ARRAY APPLICATIONS.

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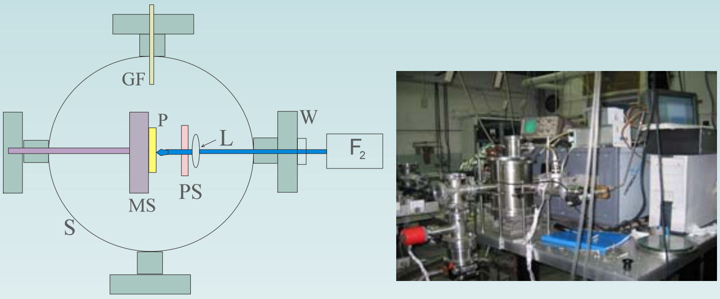
Abstract

Surface treatment and preparation of biopolymers for bio- arrays applications with lasers at 157 nm allows surface roughness depth control for optimizing surface -probe binding strength and detection sensitivity [1]. Optimization and control on the surface quality of bio-polymers, besides optimizing detection sensitivity, is accelerating hybridization time and sets the limits in relation to defect-free surface preparation from DNA immobilized strands localized on bio compatible polymer substrates. In this communication, the surface roughness from self-assembled structures on Teflon thin films was controlled with atomic resolution allowing thus optimum surface preparation for bio-array applications.

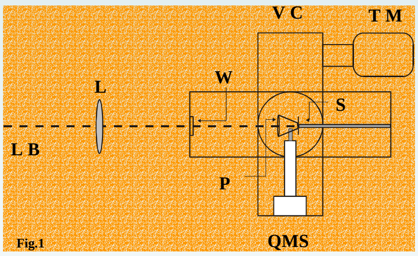
References

[1] 157 nm laser ablation of polymeric layers for fabrication of biomolecule microarrays. A. M. Douvas, P. S. Petrou, S. E. Kakabakos, K. Misiakos, P. Argitis, E. Sarantopoulou, Z. Kollia, A. C. Cefalas. *Anal. Bioanal. Chem., V381, 1027 (2005).*

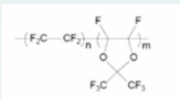
Experimental



Optical projection system.



QMS spectrometer at 157nm.



Teflon AF

•Thin films of Teflon AF (tetrafluoroethylene (TFE) and 2,2-bistrifluoromethyl-4,5-difluoro-1,3 dioxole (PDD)) 100 nm thick films were deposited on a CaF_2 window and on silicon wafer by spin coating.

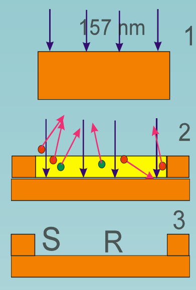
•The samples were placed inside a vacuum chamber on a computer controlled X-Y-Z translation stage and the laser fluence falling on the substrate was controlled with a CaF_2 collimation optical projection system.

•Samples were irradiated under vacuum background pressure or under N_2 fluence.

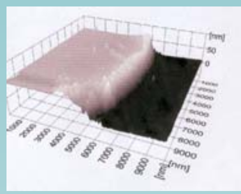
•The surface morphology of the films prior and after laser exposure was evaluated with an atomic force microscope (AFM).

•Mass spectroscopy of the Teflon at 157nm was measured with a vacuum ultraviolet QMS spectrometer.

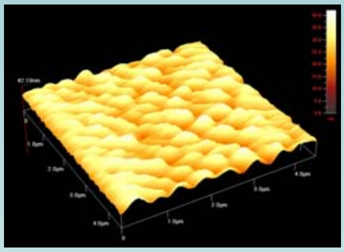
Results and discussion



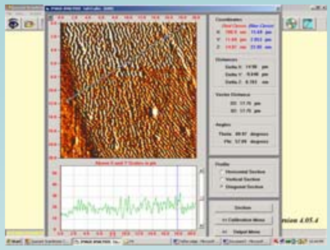
Interaction of Teflon with laser at 157nm



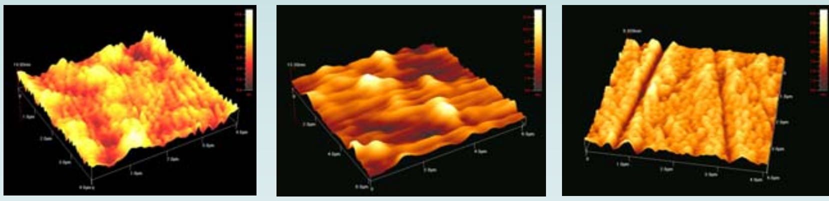
Optical images of spin coated Teflon AF solutions of less than 6% concentration (FC75 solvent) results, in locally nonuniform (rough) films in the non exposed area.



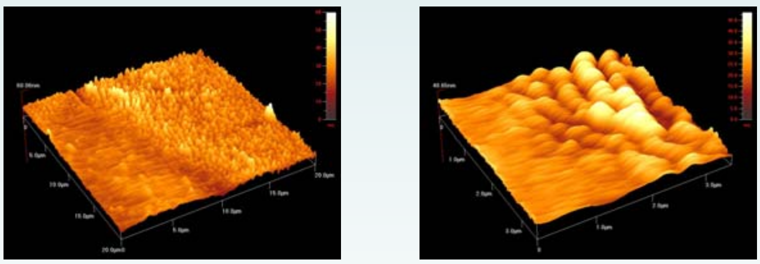
AFM image of non exposed Teflon AF 1600 TAF 1%. The surface roughness is around 40nm.



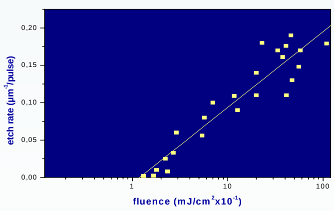
2D AFM image analysis of the edge between exposed-non exposed Teflon AF.



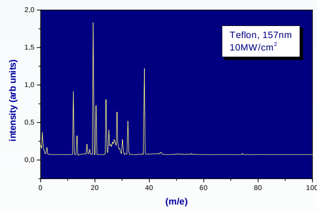
AFM image of Teflon AF 1600 TAF 1% following laser illumination at 157nm with 100 nm laser pulses at 1mJ/cm² per laser pulse, the surface roughness on the film surface is enhanced (a). Further increasing the laser energy (b) and (c), the surface roughness of the film is changing from 14 to 8nm.



3D-AFM images of the edge between exposed and non exposed areas in Teflon at 157 nm.



Etch rate of the Teflon at 157nm



Mass spectrum of the Teflon at 157nm

Conclusions

The surface roughness from self-assembled structures on Teflon thin films can be controlled with atomic resolution allowing thus optimum surface preparation for bio-array applications.