

Patterning of Plasma Polymers for Bioarrays

G. Mishra, S. L. McArthur

Department of Engineering Materials, University of Sheffield, UK

INTRODUCTION: Modern day technological advancements have allowed us to overcome critical challenges posed in proteomic research. As a direct result of developments in miniaturization and automation, the current market has seen ever growing numbers and varieties of high density arraying slides being used for proteome research and application. Needless to say that these developments have been matched with state of art instrumentation and data analysis packages to achieve true automated multiplex analysis. Yet, issues like non-specific adsorption of biomolecules to solid substrate and control over the orientation during immobilization need addressing. Key to these issues could be the precise control over surface modification and patterning. Plasma polymerisation presents a versatile approach to surface modification of these devices. The range of monomers available for plasma polymerisation makes this manufacturing approach even more suitable for use in systems where multiple coatings with specific properties are required for a single device. The ability to spatially define reactive regions to reduce non-specific background adsorption is integral to this project.

METHODS: Characterisation of Plasma polymers, X-ray photoelectron spectroscopy (XPS), Time-of-Flight Static Secondary Ion Mass Spectroscopy (ToF-SSIMS), ATR Fourier Transform Infrared Spectroscopy (FTIR), fluorescence microscopy

RESULTS & DISCUSSION: In this study we use plasma polymerisation technique to functionalise a surface for physical and covalent attachment of biomolecule in a controlled fashion. Various patterning techniques including photolithography and physical masks have been used to compare the resultant pattern resolution and chemical functionality using XPS, ToF-SIMS and AFM. Plasma polymerisation has been used in conjugation with photolithography thus allowing us to simultaneously obtain high spatial and chemical resolution. Multivariate analysis of ToF-SIMS spectral and image data has allowed us to not only optimise the system to retain maximum chemical functional groups but also to critically study and address issues associated with the chemical specificity and spatial resolution of the multilayer patterning approach. Our results suggest that complex multilayer plasma coatings can be produced without compromising the chemical properties of the deposited polymer layers.

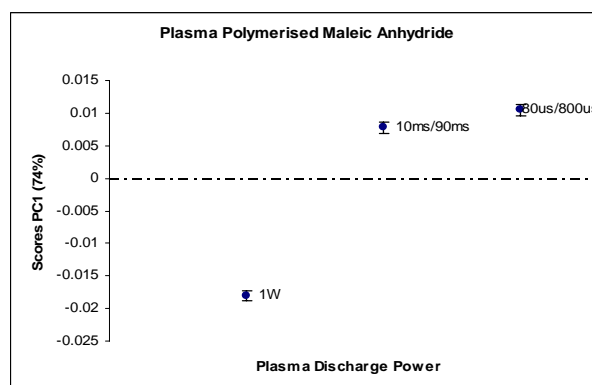


Figure 1: Scores for the first PC of positive ion ToF-SIMS spectra of maleic anhydride plasma polymer showing higher functional group retention under μ s pulse plasma discharge condition.

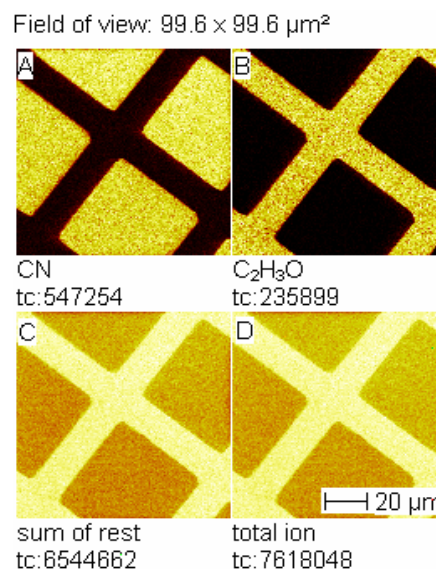


Figure 2: Negative ion ToF-SSIMS image showing regions of (a) plasma polymerised allylamine surrounded by background region of (b) plasma polymerised tetraglyme. Photolithography was used as a patterning technique in this case.

CONCLUSIONS: We have demonstrated that photolithography can be adapted to pattern plasma polymers for bioarray applications. High chemical and spatial pattern resolution can be achieved by using this technique.