

FUNCTIONAL POLYSILOXANE-G-POLY(ETHYLENE GLYCOL) LAYERS ON GOLD SURFACE: SURFACE CHARACTERIZATION AND RESISTANCE TO PROTEIN ADSORPTION

C.Zhou^{1,3}, V.K.Khlestkin², W.Laureyn¹, G.Reekmans¹, A.Campitelli¹, G.Borghs¹, W.Dehaen² & Y.Engelborghs³

¹Interuniversity Microelectronics Center (IMEC), Belgium. ²Dept. of Chemistry, KULeuven, Belgium.

³Lab. of Biomolecular Dynamic, Dept. of Chemistry, KULeuven, Belgium.

INTRODUCTION: Protein resistant surface is a prerequisite for bioaffinity sensing, where the selectivity and sensitivity of the antigen/antibody assay is directly related to how well the nonspecific adsorption can be suppressed. From the point of view of stability, polymeric monolayers are better candidates for surface modification compared to SAMs [1]. In addition, it is well known that poly(ethylene glycol) (PEG)-containing surfaces show outstanding protein resistance properties [2]. In this report, the synthesis, deposition and performance of a series of PEG grafted polysiloxanes is described. These PEG functional polymers can chemisorb onto Au surface by means of the grafted alkyl disulfide side chain. These polymeric monolayers show enhanced protein resistance properties.

METHODS: The synthesis was achieved by simultaneously grafting alkylenyl Disulfide and allyl-PEG onto poly(hydrogen methylsiloxane) (figure 1). Polymeric surfaces were prepared by immersing Au substrate into 1mM polymer solutions in toluene or water for a designed time. Fibrinogen (FB) (0.46mg/ml) was selected for protein resistance tests. For Surface Plasmon Resonance (SPR), the degree of protein adsorption is reported in refractive units (RU). For the QCM-DTM, the degree of protein adsorption is reported in frequency shift (ΔF (Hz)).

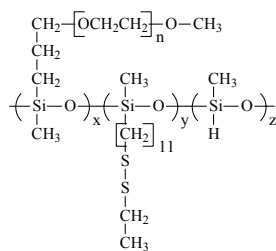


Fig. 1: the structure of the grafted polymer, nomenclature is as follows: S_{13} -PHMS_R-PEG_W, R = x/y, which is the graft ratio of PEG to disulfide. W is the MW for grafted PEG.

RESULTS: The Cyclic Voltammetry (CV) was performed (in Fe(CN)₆^{3-/4-}) for polymer surfaces prepared by 5hrs immersion. The typical oxidation/reduction peaks for clean bare Au were greatly suppressed after polymer deposition. The integrated area of CV curve for clean bare Au was 1.45mC, while integrated areas of CV curves for polymeric surfaces were lower than 0.14mC.

Water contact angles were measured for polymer surfaces prepared using different immersion times. (Table 1)

Table 1. Advancing Water Contact Angles of polymers on Gold.

Polymers	Immersion time		
	2hr	4hr	6hr
S ₁₃ -PHMS ₅ -PEG ₆₀₀ (toluene)	56	66	65
S ₁₃ -PHMS ₈ -PEG ₆₀₀ (toluene)	51	54	56
S ₁₃ -PHMS ₈ -PEG ₁₁₀₀ (toluene)	44	43	44
S ₁₃ -PHMS ₈ -PEG ₁₁₀₀ (water)	28	29	29

The protein resistance was test by SPR and QCM. (Table 2)

Table 2. The FB protein resistance property.

	SPR (RU)	QCM (Hz)
Hydrophobic surface		405
Clean bare Au	5000	
S ₁₃ -PHMS ₈ -PEG ₁₁₀₀ (water)	45	15

DISCUSSION & CONCLUSIONS: CV analysis indicated that these polymers chemisorb to Au and the surface coverage is high. The polymer surfaces demonstrate hydrophilic property, which depends on the PEG ratio, MW of PEG and solvent. The polymer surface shows outstanding protein resistance property.

REFERENCES: ¹Xia N, Hu YH, Grainger DW and Castner DG (2002) *Langmuir*, 18:3255-3262. ²Feldman K, Hähner G, Spencer ND, et al (1999) *J. Am. Chem. Soc.* 121:10134-10141.

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