A BLOCK COPOLYMER THIN FILM ROUTE TO HIGH THROUGHPUT BIOSENSORS

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A facile method for obtaining nanoporous block copolymer thin films via a supramolecular chemistry technique has been developed, in particular using the block copolymer, polystyrene-b-poly(4-vinyl pyridine) (PS-b-P4VP), and small molecules such as naphthol (NOH) [1,2]. The NOH hydrogen bonds to the P4VP block during the film-forming process, and is easily washed out post-film formation by a selective solvent (methanol), resulting in a thin film characterized by quasi-hexagonally ordered nanopores within a PS matrix. The nanopores are lined with P4VP, which can be exploited as a functional lining for immobilizing nanoarrays of desired molecules, such as peptides and proteins, in a quasi-hexagonal pattern through strong non-covalent or covalent attachment. These functional nanotemplates are thus potentially interesting for the development of high throughput biosensors.

In proof-of-principle studies, we have applied the strategy of using the supramolecularly produced functional nanotemplates to the ionic docking of, first, dodecyl benzene sulfonic acid (DBSA) to the P4VP-lined pores via proton exchange reactions and, second, the sodium salt of DBSA to (partially) quaternized P4VP-lined pores via ion-exchange interactions. The latter approach was found to be the most successful. It was followed up by binding investigations of the Na salts of 4-sulfophenyl isothiocyanate (SPITC) and of SPITC-modified Glu-Cys-Gly peptide to partially quaternized thin films. The surface modification, the success of the attachment, and its stability in neutral, highly acidic and physiological aqueous conditions, were studied principally by atomic force microscopy, water contact angle measurements, and reflection-absorption infrared spectroscopy. Viable preparation methods to assure confinement of the P4VP to the pores (by reduction of the methanol rinse time to 1-2 min), to stabilize the PS matrix (by UV-visible cross-linking), and to avoid non-specific interactions of proteins with PS (by passivation with BSA, bovine serum albumin) were also addressed in this work.

References:

[1] A. Laforgue, C.G. Bazuin, R.E. Prud'homme, Macromolecules, **39** (2006) 6473.
[2] A. Sidorenko, I. Tokarev, S. Minko, M. Stamm, J. Amer. Chem. Soc., **125** (2003), 12211.

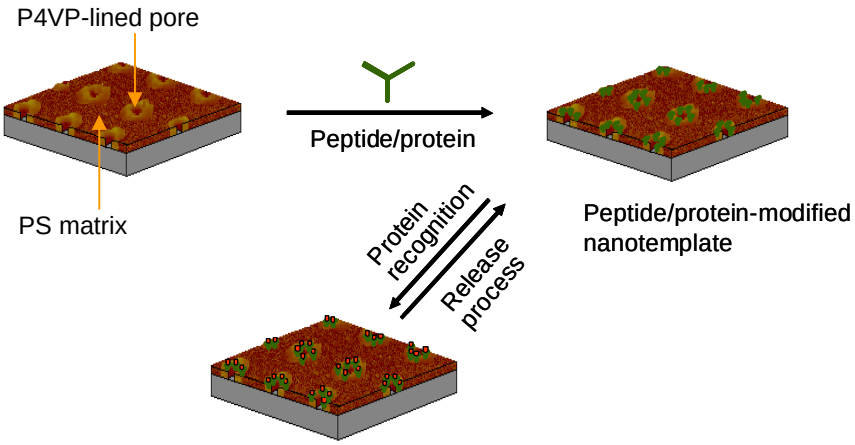

Figure 1. Schematic of a supramolecularly produced nanoporous thin film composed of the polystyrene-poly(vinyl pyridine) (PS-P4VP) block copolymer, used as a functional nanotemplate for the binding of peptides/proteins for protein recognition and release. This strategy is of potential interest for the development of high throughput biosensors.