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Chemicals micropatterning of polycarbonate for biomolecular interactions

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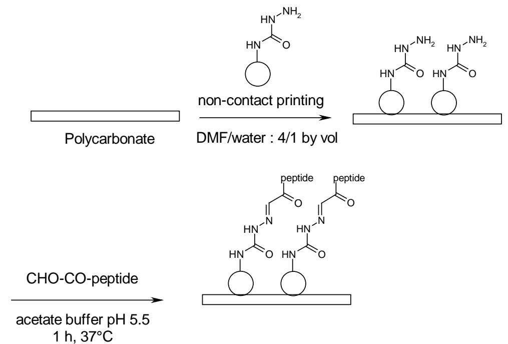
Introduction

Polycarbonate (PC) is a useful substrate for the preparation of microfluidic devices. Its utility for bioanalysis has also attracted much attention owing to the possibility to use compact discs as platforms for studying biomolecular interactions on a large-scale. Chemical modification of the surface of polymers such as PC is more difficult : PC is degraded by aqueous bases, swelled or solubilized by various organic solvents and cannot be exposed to temperatures exceeding 115°C. Thus, the design of simple and harmless functionalization methods for PC is of great interest and should widen its use for biosensor fabrication.

Method

The method is based on the printing of functionalized silica nanoparticles on PC (∅ from 27 to 304 nm). The semicarbazide groups present on the surface of the nanoparticles were used for the site-specific immobilization of unprotected peptides derivatized by an α-oxo aldehyde group through the formation of a α-oxo semicarbazone bond, a useful chemistry for the anchoring of biomolecules to SiO_2 substrates (Scheme 1).



Results

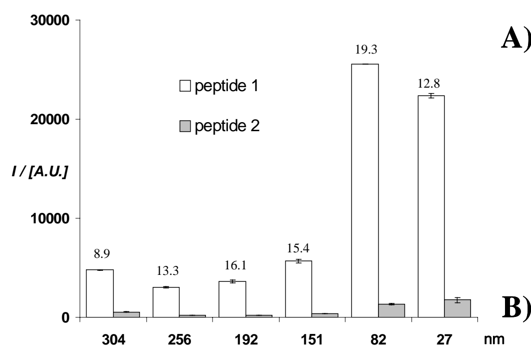
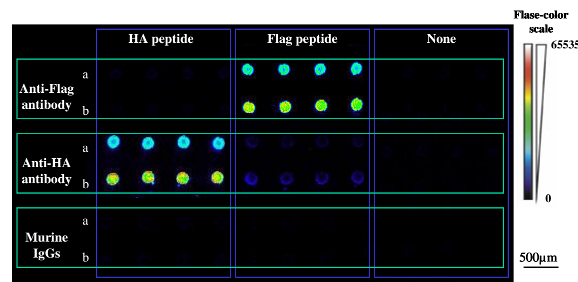


Fig. 1. Reactivity of semicarbazide nanoparticles printed on PC (1% w/v in DMF 4/1 v/v, 3 drops, 1 nL). The PC slides were incubated with Rho-Lys-Arg-$NH(CH_2)_3NHCOCHO$ **1** or Rho-Lys-Arg-$NH(CH_2)_3NHCOCHO$ **2** peptides (0.1 mM in pH 5.5 sodium acetate buffer). Fluorescence was determined with a microarray fluorescence scanner at 532 nm. The data correspond to the median and interquartile range for 3 slides. The ratio between the signals obtained with peptides **1** and **2** is indicated at the top of the bars.

A)



B)

C)

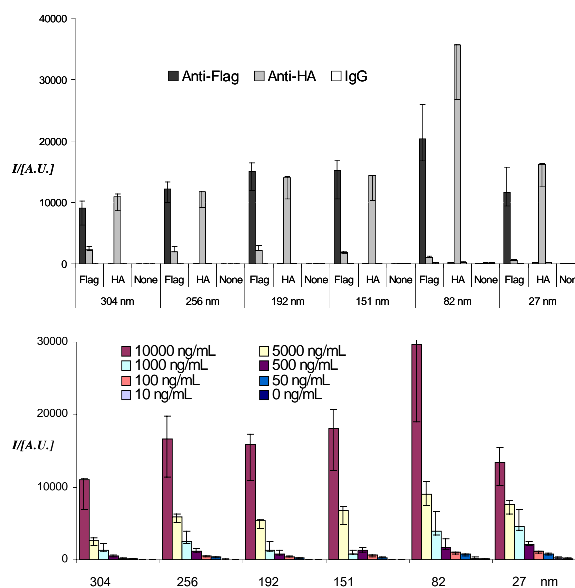


Fig. 2. HA or Flag peptides were immobilized on PC through a nanoparticle layer. The surfaces were incubated with anti-HA, anti-Flag or murine IgGs and then secondary antibodies against murine IgGs labeled with tetramethylrhodamine. The surfaces were analyzed at 532 nm using a standard fluorescence scanner. A) Typical 16-bit images (false-color scale), a: 27 nm, b: 82 nm. The other diameters are not shown. Antibody concentration : 10 µg/mL. B) Fluorescence intensities obtained by incubating the surfaces with anti-HA antibody (grey bars), anti-Flag antibody (black bars) or murine IgGs (white bars). Antibody concentration : 10 µg/mL. C) Flag-micropatterns were incubated with different concentrations of anti-Flag antibody from 0 to 10000 ng/mL. For B) and C) fluorescence intensities (arbitrary units) correspond to the median and interquartile range for 3 slides (4 replicates per slide).

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