Supporting Information

Size Selective Deposition and Sorting of Lyophilic Colloidal Particles on Surfaces of Patterned Wettability

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Experimental

Materials

All glassware was soaked in H₂SO₄-Nochromix solution (technical grade, Fisher Scientific) overnight and rinsed with filtered and deionized water with a resistivity of at least $18.0M\Omega$ cm (Millipore Milli-Q50). This was water also used to clean all substrates and to prepare all aqueous solutions. All chemicals were used as received without further purification. All particles used in this study were made of polystyrene, including amidine-functionalized spheres (Interfacial Dynamics, Corp.) with diameters of 210 nm with cv 7.9%; 810 nm (which were dyed red) with cv 2.7%; and 2.1 µm with cv 3.2%, (where cv is the reported coefficient of variation from the mean) and streptavidin-labeled polystyrene particles (Bangs Laboratories, Inc.) with diameters of 900nm (no standard deviation reported) and 5.46 µm with a reported standard deviation of 0.34µm. The 900 nm spheres were bound to a biotinylated dye, biotin-4-fluorescein, which can be excited at 494nm to emit green light at 523nm. The 5.46 μ m spheres were bound to another biotinylated dye, Alexa-fluor 594 biocytin, which can be excited at 591nm to emit red light at 618nm. Both dyes were purchased from Molecular Probes. All particles were first washed by centrifugation with, and then suspended in distilled water of pH 2 (adjusted by the addition of HCl, ACS grade, purchased from JT Baker) at volume fractions of 0.01%. This pH was selected to prevent disassociation of the carboxylic-acid headgroups in the patterned self assembled monolayers (described below).

The patterned surfaces were made using octadecanethiol (98% purity) and mercaptohexadecanoic acid (90% purity) in ethanol (200 proof). All solvents and surfactants were purchased from Aldrich.

Patterned Substrates

Substrates were prepared from silicon (111) wafers (Montco Silicon Technologies, Inc.) coated with 1-3 nm of Cr as the adhesion layer and 100 nm of Au. Patterned self-assembled monolayers (SAMs) were formed using microcontact printing, a standard technique reviewed briefly here. Elastomeric polydimethylsiloxane (PDMS) stamps with various microstructures were inked with a 1 mM solution of $HS(CH_2)_{15}COOH$ in ethanol, brought into contact with the gold surface for 1 min, and rinsed with ethanol to produce discrete domains covered with a carboxylic acid terminated SAM on the substrate. The substrates were subsequently immersed in a 1 mM solution of $HS(CH_2)_{17}CH_3$ in ethanol for 1 hour to cover the remainder of the surface with a methyl-terminated SAM. A homogeneous SAM of $HS(CH_2)_{15}COOH$ has an advancing contact angle of 31° with water at pH 2; a homogeneous SAM of $HS(CH_2)_{17}CH_3$ has an advancing contact angle of 103° with water at pH 2.

Experimental Protocol

In the evaporation experiments, a 50 μ L drop containing suspended particles was deposited on the patterned surfaces. All experiments were performed at 20% relative humidity and at 25°C; for these conditions and these drop volumes, drops evaporated completely in approximately 3 hours.

In the dip-coating experiments, a dip-coating apparatus exploiting a stepper motor allowed withdrawing speeds to be controlled in the range of micrometers per minute; all experiments reported in this work were performed at a withdrawal rate of 100µm/min. The substrates were withdrawn from a 10 ml Teflon beaker filled with the suspension of interest. The dip coating experiment was performed with reservoirs of water nearby was used to maintain the relative humidity.

The structures formed were imaged after the drop or dip-coated film had evaporated. Optical and fluorescent micrographs were taken using a Nikon Eclipse ME 600L microscope equipped with a CCD camera. A JEOL JSM-6700F field emission scanning electron microscope was used to identify smaller particles.