Spatial Control over the Anion-Exchange Process using Contact Printing

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Surface patterning is an old, yet growing discipline within the field of chemistry, engineering, and materials science. While there are countless ways to pattern a surface, each of them relies on one requirement, the ability to control where and when chemistry occurs. We are interested in using anion-exchange chemistry as the means to controllably functionalize a cationic polymer coating. With this in mind, we have developed contact printing techniques as our principle method for patterning this chemistry on to a polymer. Contact printing is widely used to create patterned monolayers on gold and glass surfaces, and is amenable to scale up using high-throughput techniques. There are few examples of how anion-exchange chemistry may be applied to this technique. Using standard photolithography fabrication processes available at the Western Nanofabrication Facility, patterned poly(dimethylsiloxane) (PDMS) molds may be fabricated with ease. Figure 1 demonstrated how molds functionalized with a hydrophobic anion such as dodecylbenzene sulfonate and brought in to contact with the cationic polymer facilitating the anion-exchange reaction. Regions of the polymer substrate that are in contact with the PDMS mold undergo a change in interfacial properties. Due to the presence of the hydrophobic anion, these regions repel water. The regions that were not in contact however remain hydrophilic, allowing water and an anionic dye such as sodium fluorescein to permeate the polymer and undergo additional anion-exchange chemistry (Figure 1). This orthogonal behaviour in water permeation can only occur by directed patterning. Using this general process, virtually any anion may be patterned in a controlled manner. Future work includes miniaturization of this process for microtechnology applications.

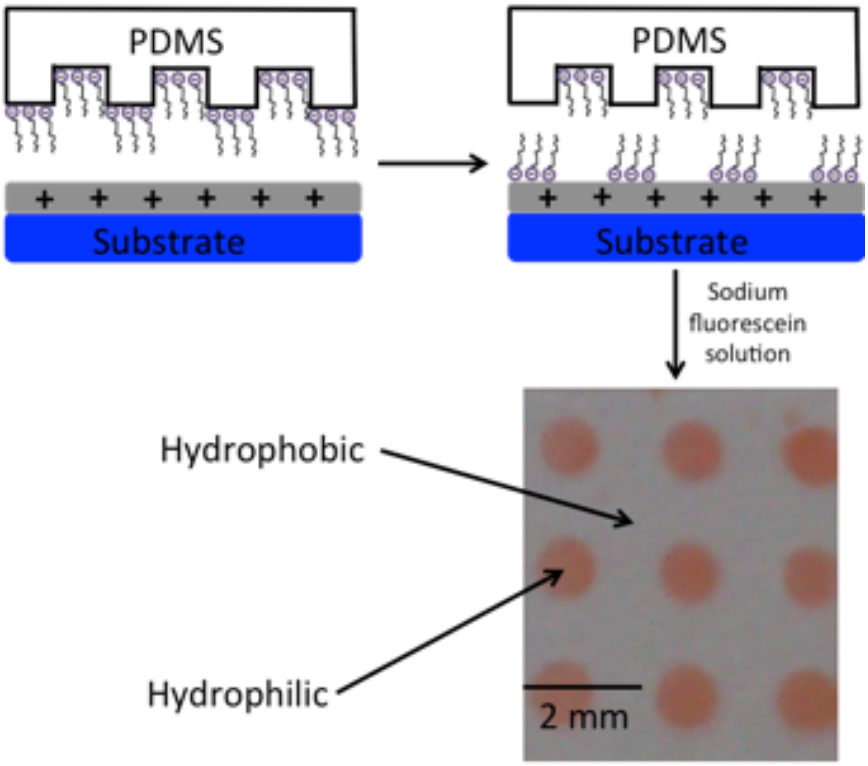

Figure 1: Scheme for the contact printing process on a cationic polymer substrate.

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