A polymer-supported microcontact printing (μCP) routine for submicroscale patterning of capillary-active interfaces and hydrogels

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We present an innovative μCP technique that enables highly precise patterning of capillary-active surfaces and hydrogels. This method uniquely combines exceptional spatial resolution with the ability to generate chemically functionalized regions directly at the printed sites. A polymer brush-supported printing strategy is central to this method.[1]
In this approach, polymer brushes are grafted onto an elastomeric polydimethylsiloxane (PDMS) stamp, which facilitates controlled and reactive ink transfer. The ink molecules are first immobilized within the polymer brush matrix through chemical attachment. Upon contact with the substrate, these molecules are transferred and form irreversible bonds with the surface. This mechanism effectively suppresses undesired ink spreading or smearing, a common limitation in conventional microcontact printing techniques, resulting in sharply defined and highly reproducible patterns.
Using this method, chemically well-defined patterns can be transferred with excellent local precision. Its versatility further broadens its applicability: a wide range of substrates—including (i) oxidic surfaces,[2, 3] (ii) cellulose,[4] and (iii) glycan-containing hydrogels[5] – can be functionalized (Figure 1). Moreover, the technique is not limited to planar systems; it can be extended to complex and curved geometries, enabling the modification of microscale objects such as microparticles[6] and even cellular interfaces.[5]
This adaptability opens up opportunities across multiple scientific and technological domains. By integrating microscale accuracy, chemical specificity, and broad substrate compatibility, the polymer brush-supported μCP approach represents a significant advancement in surface engineering, biointerface design, and materials science.

Keywords:
Microcontact printing, polymer brushes, patchy particles, surface patterning

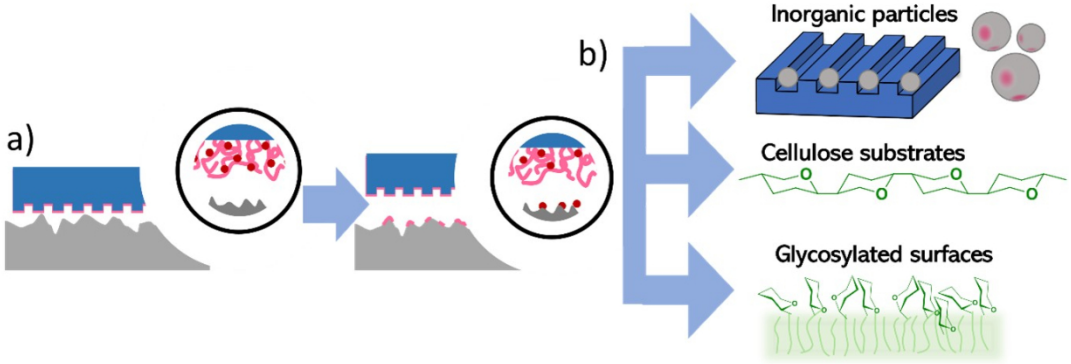

Figure 1: Polymer brush-supported μCP. a) Principle. b) Possible substrates.

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