Poster

PATTERNING BIOLOGICAL HYDROGELS BY SOFT LITHOGRAPHY

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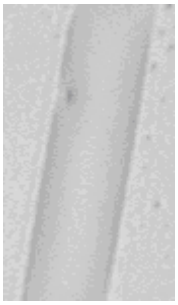
Hydrogels are cross-linked polymeric materials swelling in water without dissolving. These network polymers are biocompatible materials, presenting a water content close to that of the human tissues and pore dimension comparable to cells. For these characteristics, they have become some of the most promising candidates for tissue engineering. In addition, the high mobility of hydrogel surfaces may also have specific advantages for binding of functional proteins, and it is unlikely to lead to protein denaturation.
Other applications of the hydrogels include biosensor and drug delivery systems, since they exhibit significant volume changes in response to small changes in pH, temperature, electric field, and light, and upon controlled drug release.

The most widely used hydrogel systems are based on the polymerisation of a mixture of monomers, cross-linking agents, and initiators. This approach is suitable for a broad range of applications, because some parameters such as hydrogel composition, cross-linking properties, biocompatibility, and sensing capability can be easily adjusted by acting on the initial composition. Polyacrylamide gel is widely employed for analyzing and preparing DNA molecules. It may be cast in a variety of polyacrylamide concentrations, ranging from 3.5% to 20%, depending on the sizes of the fragments of interest. The chemical and physical properties of polyacrylamide make them ideally suited for many applications, particularly in the growing biotechnology area.

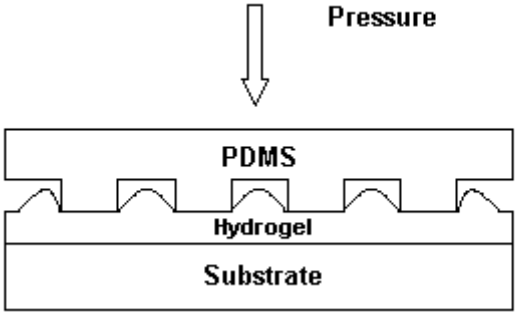
For their chemical flexibility and the broad range of applications, the direct patterning of biocompatible hydrogels structures certainly deserves to be fully explored. This paper describes methods to create hydrogel micropatterns of polyacrylamide by soft lithography (Fig. 1), that can find application in the area of on-chip electrophoresis. Room-temperature molding (Fig. 2) is employed in order to directly transfer micro- and nanostructures into polyacrylamide gel. During the imprinting process, the mold is placed onto a cast film of the gel. The gel at the liquid state can flow and can be deformed into the shape of the stamp, driven by a combination of spontaneous capillarity and pressure-induced transport, without using any photon-beam, solvent, and chemical surface treatment. After the polymerisation of the system, a negative copy of the stamp pattern is so frozen on the target material surface. In this way we could create bio-hydrogel topographical patterns useful for many applications, including biotechnologies, optics, controlled bio-scaffold, microcontact printing [1] and microfluidics [2] applications.

References:

[1] N. Sgarbi, D. Pisignano, F. Di Benedetto, G. Gigli, R. Cingolani, R. Rinaldi, Biomat., 25 (2004) 1349.
[2] D. Pisignano, F. Di Benedetto, L. Persano, G. Gigli, R. Cingolani, Langmuir, (2004), in press.



Figures 1: Single 100μm wide hydrogel feature produced by soft lithography.



Figures 2: Scheme of the patterning process (features not in scale)