Approaches for surface patterning and functionalization: towards hierarchical structures

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The use of polymeric materials for targeted applications has been always accompanied by the functionalization of the surface. Thus, whereas hydrophilic functional groups have been introduced to improve wettability, adhesion or biocompatibility, surface hydrophobic groups decrease the surface tension and enhance the water contact angle. Today and based on the investigations performed on natural systems there is a general agreement that not only the surface chemical functionality but also the surface pattern plays a key role on their final properties. For instance, the extreme water repellency in Lotus plants is a combination of hydrophobic chemical composition and multiscale patterning at the micro- and nanoscale. This is not the only case found in nature in which the multiscale order leads to unexpected properties but others include the adhesion of the Gecko, the antireflective surfaces of flies or the iridescence of insects and birds.

Based on the unique properties of multifunctional surface structure our group is involved in the design of such systems by using two approaches acting simultaneously. The functionalization of the polymer surfaces occurs by surface segregation of additives upon annealing. The design of the additive allows us to control the surface chemistry and the functional density. The structuration has been obtained in our group by two different approaches, either using the breath figures mechanism or by using lithography. In this lectures, we will illustrate with few examples these strategies and the surface properties resulting.