Electro-responsive polyelectrolyte-coated surfaces

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Anchoring of polymer chains at solid surfaces is an efficient way to modify interfacial properties like stability and rheology of colloidal dispersions, lubrication or biocompatibility. Polyelectrolytes are good candidates to build smart materials (materials that can change their properties in response to a changing environment), as polyion chain conformation can often be tuned by variation of different variables. However, acheving an efficient and reversible control of this process represents an important technological challenge. In this regard, the application of an external electrical stimuli on polyelectrolytes seem to be a convenient control strategy, for several reasons. First, it is relatively easy to apply an electric field to the material. In addition, as opposite to chemically induced changes, the molecular response to a changing electric field occurs relatively quickly. This response can be used to tune the magnitude of surface properties.

In this work we discuss the effect of an external electric field on the wettability and lubricant properties of a number polyelectrolyte-coated surfaces. The influence of the aplied field is investigated at different pH and salt conditions, as the polyelectrolyte conformation is sensitive to these variables. We show that it is possible to fine tune friction and wettability using relatively low applied fields. Many applications can be envisaged for the process described here. Friction and wear reduction in water-based environments, surface patterning or real-time control of tactile sensations are just some examples. These methods can also be used to investigate in-situ molecular structure and relaxation process under confinement. We will discuss a model based on polyeletrolyte theories to describe the observed behavior.