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Surface Modification by the Reversible, Electrochemical Deposition of Polyelectrolyte Complex Films

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Polyelectrolyte complex films made from oppositely charged polymer chains have applications as drug delivery vehicles, separation membranes, and biocompatible coatings. Conventional layer-by-layer techniques for polyelectrolyte coatings are low-throughput, multistep processes that are quite slow for building films on the order of micrometers. We have developed electrochemical processes for depositing thick (¿ 1 μm) films within short experimental time scales (5 min). This rapid electrodeposition is achieved by exploiting the reduction of hydrogen peroxide at the working electrode, triggering the pH responsive self-assembly of a polyelectrolyte complex film composed of poly(acrylic) acid and poly(allylamine) HCl. In situ rheology using an electrochemical quartz crystal microbalance (EQCM) quantified the viscoelastic shear modulus of the films at a frequency of 15 MHz. The EQCM technique is ideally suited for basic studies of salt and pH-induced swelling, dissolution and deposition of PEC films. The dissolution/redeposition cycle is significant in that it provides route to resettable fouling release surfaces.