# THEORY OF POLYELECTROLYTE MULTILAYERS

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Polyelectrolytes are macromolecules that acquire electrical charges on dissolution in water. Polyelectrolyte multilayers (PEMs) can be produced by multiple alternate dipping of a charged surface into a polycation and a polyanion solutions.

PEMs exhibit remarkable properties like a high mechanical stability, a strong dependence of the adsorbed amount on the number of immersion steps (of sublayers), and high sensitivity to pH and to salinity of the solution. PEMs have numerous applications ranging from the design of thin films containing proteins, nucleic acid or peptides with targeted properties to fabrication of microcapsules and functional films for biosensing, catalysis and optical devices.

However, the theoretical understanding of the properties of PEMs is still limited. The project is to analyse theoretically a few simple yet rigorous statistical mechanics models of PEMs to elucidate their most salient equilibrium properties. The models are targeted at elucidation of molecular mechanisms responsible for both the linear and the exponential growth modes of the PEM total thickness with the number of sublayers. Both computer modelling and analytical research are anticipated. The first goal is to simulate the layer-by-layer formation procedure starting with a low ionic strength, and to study how the multilayer structure changes with an increase of the salt concentration. The work on weakly charged polymers will be followed by studies of the strongly charged systems.

The candidate must have a profound knowledge of the statistical physics of polymers and/or of computer simulation techniques applicable to systems of chain molecules with Coulomb interactions.