# Polyelectrolyte Microcapsules as Container for Nanoparticle Cynthesis

Gleb Sukhorukov[1]

[1] Max Planck Institute of Colloids and Interfaces
MPIKGF, Muhlenberg 1
Golm/Potsdam 14424
Germany

A novel approach to fabricated nanoengineered microcapsules has been recently introduced. The method consists in layer-by-layer adsorption of oppositely charged macromolecules onto colloidal particles. Different templates with size ranged form 50 nm to tens of microns, such as organic and inorganic colloid particles, protein aggregates, emulsion droplets, biological cells and drug nanocrystals can be coated by multilayer film. Various materials, e.g. synthetic polyelectrolytes, chitosan and its derivatives, proteins, DNA, lipids, multivalent dyes and magnetic nanoparticles, have been used as layer constituents to fabricate the shell. The possibility to use various materials allows proper design of shell to adjust required stability biocompatibility and affinity properties of the capsules. Some colloidal templates can be decomposed at conditions where the polymer shell is stable, what leads to the formation of hollow capsules which have a determined size, shape of initial colloids and wall thickness tuned in nanometer range by number of alternated layers.

The permeability through the capsule wall and release of the encapsulated materials depend on the shell wall thickness and composition and can be regulated afterwards by pH, ionic strength or solvent exchange. The molecular weight selective permeability provides capturing of enzymes, while the small substrates and products of enzymatic reactions can penetrate capsule wall.

Several approaches on macromolecule encapsulation into these capsules are developed. This possibility of switching the capsule walls at the pH closed to pK of polyelectrolyte used as layer constituents between an open and closed state provides a convenient and efficient tool to control the uptake and release of polymers, biopolymers and nanoparticles.

The capsules were loaded at low pH and after increasing the pH the material is captured inside. The presence of polyelectrolyte only on one side of the capsule wall leads to establish pH-difference across the capsule wall. It has been utilised for iron oxide particle synthesis, different magnetite particles, yttrium florid particles or precipitation of dyes or drug with pH-dependent solubility in capsule interior. Thus, small molecules (dyes, drugs) can precipitate into restricted volume of capsule with determined size and shell composition. These polyelectrolyte capsules are supposed to be used as carriers for biological species, for the controlled release and targeting of drugs and as microcontainers to perform chemical reactions in restricted volumes