ML 04

POLYELECTROLYTE COMPLEX NANOPARTICLES WITH NARROW SIZE DISTRIBUTION: PREPARATION AND PROTEIN BINDING

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Polymer nanoparticles are progressively used for the immobilisation, storage or carriage of drugs or proteins. In that context the nano dimension offers a high surface/volume ratio and the correlation with structural sizes of biological systems. The aim of our work is to prepare nanoparticles on the basis of polyelectrolyte complexes (PEC) and to explore their interaction to pharmaceutical and biomedical relevant compounds. Especially the reproducibilty in the preparation protocol, the size and shape uniformity and the conservation of colloidal stability after binding of compounds are main issues of our research.

Typical PEC dispersions were prepared by mixing solutions of poly(diallydimethylammonium chloride) (PDADMAC) and poly(L-lysine) (PLL) with those of copolymers of maleic acid (PMA-X) or poly(styrenesulfonate) (PSS) followed by consecutive centrifugation and redispersion [1]. Important parameters were the molar mixing ratio of charged units (n-/n+), concentration, pH and ionic strength. Dynamic light scattering, colloid titration and circular dichroism were applied for the dispersions as well as scanning force microscopy (SFM) and infrared spectroscopy for particle layers.

First of all PEC raw dispersions show polymodal size distributions of the nanoparticles. However, applying consecutive centrifugation, separation and redispersion steps of the coacervate phase monomodal size distributions could be achieved, which can be explained in terms of an “accelerated ripening” (Ostwald) of the raw dispersion. We assume aggregation of primary PEC particles ($\geq$ 10 nm) to secondary PEC particles ($\geq$ 75 nm, coacervate phase) as well as larger precipitate structures via dispersive forces, while the secondary particles obtain colloidal stability by electrostatic repulsion between the particle shells, which consist of the excess polyelectrolyte. Via n-/n+ anionic and cationic particles and via concentration, pH and ionic strength PEC particles with defined sizes can be can be generated. Experimental findings were supported by recent simulation studies [3]. Moreover, beside classical spherical PEC particles also needle-like ones can be obtained, if stiff polyelectrolytes are used [2]. Finally, model proteins could be bound at PEC nanoparticles under electrostatically repulsive conditions and the formed PEC/protein conjugate particles showed stability and size uniformity comparable to unmodified ones [4].

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Literature

1. M. Müller, B. Keßler, S. Richter, *Langmuir*, 21(15), 7044-7051 (2005)
2. M. Müller, T. Reihs, W. Ouyang, *Langmuir*, 21(1), 465-469 (2005)
3. V. Starchenko, N. Lebovka and M. Müller (submitted)
4. W. Ouyang and M. Müller, *Macromol. Bioscience*, 6, 929-941 (2006)