BIOMACROMOLECULES AND BIOHYBRID SYSTEMS – IN-SITU CHARACTERIZATION OF INTERACTION PROPERTIES

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ABSTRACT

The intermolecular interactions of functionalized amphiphilic, core-shell or dendronized polymers with emphasis on bioactive interactions draw increasingly the research interest in the polymer community. These systems are characterized by highly complex composition, taking into account self-assembled polymer systems, complexed drugs or biopolymers and responsiveness against external stimuli – all properties which have to be considered for the development of effectively working biomaterial. The characterization of biocomplexes and aggregation behaviour of bioactive molecules led to the development of novel physicochemical approaches with high application potential. Examples are complexes based on dendritic core-shell molecules, which serve as a host for dyes, drugs and other small molecules. For most of the polymer systems trivial methods provide non-quantitative information as a result of different chemical moieties within one molecule. The determination of the distribution of the complexes or aggregates is not possible, but essential for physiological applications. We consider the field flow fractionation (asymmetrical flow, AF4) as a smooth separation technique with a variety of hyphenation possibilities suitable for this purpose. For the first time we developed an approach for the quantification of small guest molecules using the ultra-filtration effect of AF4 which leads to simultaneous information on the free guest molecules and the molar mass and size distribution of the complexes.[1] Another subject of our recent work is the bioconjugation with biomolecules of high molecular weight. Complex or aggregate distribution determination together with robust characterization of the scaling parameters can be performed depending on pH or concentration. An example based on dendronized, worm-like polymers will show full conformational and aggregation profile study based on AF4 coupled to static light scattering, dynamic light scattering as well as using complementary methods such as AFM, cryo TEM and MD simulations.[2,3] Systematic studies with variation of molecular parameters revealed a very complex picture of the aggregation behaviour which can be triggered by the pH. Furthermore, the characterization of bioconjugate systems, e.g. Biotin-Avidin, protein complexes of modified dendritic polymers and polymersomes using AF4 will be discussed.[4,5] Recent investigations on the pH-responsive behaviour of polymersomes composed by self-assembling of blockcopolymers will show the potential for drugs encapsulation or as a nanoreactor and how these functions can be controlled. [6]

References:

[1]Boye,S.; Polikarpov, N.; Appelhans, D.; Lederer,A. *J. Chromatogr. A* **2010**, 1217, 4841.
[2]Boye, S.; Appelhans, D.; Boyko, V.; Zschoche, S.; Komber,H.; Friedel, P.; Formanek, P.; Janke, A.; Voit, B.; Lederer, A. *Biomacromolecules* **2012**,13(12), 4222.
[3]Majoinen, J.; Haataja, J. S.; Appelhans, D.; Lederer, A. ; Olszewska, A.; Seitsonen, J.; Aseyev, V.; Kontturi, E.; Rosilo, H.; Österberg, M.; Houbenov, N.; Ikkala, O. *JACS* **2014**, 136 (3), 866.
[4]Ennen, F.; Boye, S.; Lederer, A.; Cernescu, V.; Komber, H.; Brutschy, B.; Voit, B.; Appelhans, D. *Polym. Chem.* **2014**, 5, 1323.
[5]Boye,S.; Ennen, F.; Scharfenberg, L.; Appelhans, D.; Nilsson, L.; Lederer, A. *Macromolecules* **2015**, 48, 4607.
[6]Yassin, M. A.; Appelhans, D.; Wiedemuth,R.; Formanek, P.; Boye, S.; Lederer, A.; Temme, A.; Voit, B. *Small* **2015**, 11, 1580.