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Stimuli responsive polymorphism in DNA-cationic liposomes complexes: effect of composition, pH and temperature

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DNA polyanion interacts with a dispersion of cationic liposomes forming supramolecular assemblies of regular inner microstructure –lipoplexes. They are studied as delivery vectors for genetic material. Despite the fact that cationic liposomes have been used for transfection, and commercial lipid formulations are available, their efficiency needs to be improved.

We will discuss structural polymorphism of lipoplexes formed due to DNA interaction with liposomes prepared as a mixture of neutral phospholipids and pH responsive additives:

N, N-dimethyldodecylamine-N-oxide (C12NO) is a surfactant that may exist in a neutral or cationic protonated form depending on the pH of aqueous solutions. We have observed the rich structural polymorphism of pH responsive DNA –C12NO –dioleoylphosphatidylethanolamine (DOPE) complexes. Depending on pH and the composition, complexes have shown either a condensed lamellar Lc or hexagonal phase Hc. Commensurate lattice parameters aHc~dLc were detected at selected composition and pH 4.9 –6.4 suggesting that Lc and Hc phases were epitaxially related. While at the same composition and but pH ~ 7, the mixture form a cubic phase (Pn3m) when the complexes were heated to 80 oC and cooled down to 20 oC.

Fatty acids were also investigated as pH responsive additive in liposomes prepared from neutral phospholipids (PL). Cations of Ca²⁺ were used as a mediator of DNA –FA/PL binding. The complexes DNA-PL-FA have shown the transformation from two lamellar phases to a condensed lamellar phase with increasing concentration of Ca²⁺. The DNA strands were packed in a two dimensional lattice in these complexes.

In studied systems, both the composition and also pH affect the DNA binding that varied in the range 10 –95 % of the DNA total amount as derived from spectrophotometry.

SAXS experiments were performed either at BL11-NCD beamline of Alba synchrotron or A2 beamline of Doris synchrotron in Hasylab, DESY, Hamburg.

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