DNA and cationic lipids build lipoplexes. Most commonly, these systems are used together with uncharged helper lipids as non–viral vectors for direct delivery of DNA–based biopharmaceuticals to damaged cells and tissues. Efficacy and toxicity are still two major problems that have to be faced on the way to an outstanding transfection system. Therefore, new lipids are constantly synthesized and investigated with respect to their transfection rates [1]. Here, an approach is made to correlate the transfection efficacies of new lipids with similar chemical structures to their physical-chemical properties. By the use of differential scanning calorimetry and synchrotron small– and wide–angle x–ray scattering valuable structural insights were obtained. A sub–gel like structure with a high packing density as well as a high phase transition temperature from gel to liquid–crystalline state were found for one of the lipids used. In contrast, another lipid shows a lower phase transition temperature and a reduced packing density, enhancing the incorporation of the helper lipid cholesterol needed for gene transfection. It can be shown that both lipids in mixtures with cholesterol form lamellar phases with and without DNA. Upon increasing temperature the phases containing DNA vanish. Interestingly, these temperatures are very different in the two systems studied, showing a different binding affinity of the DNA to the lipid mixtures.

Langmuir monolayers at the air-water interface can be used as an efficient model system to follow the binding of DNA to lipids. Depending on pH, both lipids can be either protonated or deprotonated [2]. The binding of DNA can be determined by infrared reflection absorption spectroscopy (IRRAS). A Bragg peak of double-stranded DNA at the surface can be obtained by grazing incidence X-ray diffraction (GIXD). The repeat distance of the aligned DNA molecules bound to the lipid monolayer changes upon compression.

References