Encapsulation of DNA by cationic and anionic disc-shaped bicelles

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Nanosize disc-shaped bicelles can be formed spontaneously by mixing long-chain lipids with short-chain lipids at suitable ratios with a relatively uniform size around a few tens of nanometers in diameter [1]. Bicelles can be doped with cationic or anionic long-chain lipids to vary their surface charges for interacting with various charged biomaterials and polyelectrolytes [2]. Charged bicelles can be used to pack the DNA for biomedical applications with the advantage of the size tenability and the relatively smaller size as compared with the encapsulation of DNA by liposomes. We demonstrated that both cationic lipid bicelle-DNA (CB-DNA) and anionic lipid bicelle-cation-DNA (AB-DNA) complexes can be prepared in aqueous solutions. As revealed by small-angle X-ray scattering and TEM, disc-shaped cationic bicelles and DNA form alternate layers in the one-dimensionally stacked aggregate. DNA molecules form ordered array encapsulated between the cationic bicelles with a DNA to DNA repeat distance of around 4~5 nm [3]. The number of the stacking layers can be easily varied from a few stacks to more than one hundred stacks by adjusting the doping percentage of the charged lipids. Such CB-DNA complexes are promising as a novel nonviral vector for gene delivery. It is also possible to form anionic bicelle-DNA complexes with the help of the divalent cation. The AB-DNA complexes can be formed in the investigated range of 10 to 100 mM calcium ion concentration using bicelles doped with 15% anionic lipid [4]. At above the critical calcium ion concentration, DNA can be packed more tightly and excess lipids are released from the DNA-ion-disk complexes to form the multilamellar ion-membrane complexes in coexistence with the AB-DNA complexes.

References

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