selves linked to proteins in a stereo-specific manner, ensuring controlled orientation of the particle-bound protein.

WO 02/056831 A2, WO 01/49265 A1, and the publications Mirzabekov et al. Nature Biotechnology 200(18): 649 - 654 (2000), Babcock et al. JBC 276(42): 38433-38440 (2001) and Grundner et al. Journal of Virology 76(7):3511-3521 (2002) describe spherical or ellipsoid paramagnetic proteoliposomes containing pure, native, and oriented seven-transmembrane segment immunogenic proteins, such as HIV surface proteins CCR5 or CXCR4. The immunogenic protein is bound onto paramagnetic particles via antibodies.

Nordlund et al., ACS NANO 3 (9) (2009): 2639-2646, relates to porous silica particles enveloped by a lipid bilayer. During manufacture in order to create the lipid envelope, silica particles are treated with vesicles, which open upon contact with the particle and form a layer on the particle.

Sharma et al., Bioconjugate Chemistry 15 (4) (2004): 942-947, describes biotin-PEG3400-bacteriorhodopsin conjugates, which are immobilized on streptavidin coated silica microspheres

Zhong et al., Langmuir 29 (1) (2013): 299-307, describes silica microspheres, modified with a PEG linker (i.e. NHS-PEG_{3000}-NHS) linked to a membrane anchor domain peptide $K_3A_4L_2A_7L_2A_3K_2$-FITC.

Summary

In one aspect of the present disclosure, there is provided a nano- or microsized particle comprising, membrane proteins immobilized to the surface of the particle and a sheet of a lipid bilayer interspaced between the membrane proteins and enveloping said particle, wherein said membrane protein is immobilized to the surface of the particle by a linker molecule with a length of at most 5.5 nm.

In a further aspect of the present disclosure, there is provided a method of manufacture of a particle with a lipid bilayer envelope as described herein, comprising the steps of providing a nano- or microsized particle, immobilizing membrane proteins to the surface of the particle, adding amphiphilic molecules suitable to form a lipid bilayer, thus providing particles with said lipid bilayer envelope.

In another aspect of the present disclosure, there is provided a method of testing a biological activity of a membrane protein, comprising providing a particle as described herein and

assaying for the biological activity of a membrane protein within the lipid bilayer enveloping the particle.

In a further aspect of the present disclosure, there is provided a method of assaying a membrane protein for its capability of binding a candidate binding substance, comprising providing a particle as described herein, adding a candidate binding substance and determining binding events of said candidate binding substance and the membrane proteins in the lipid bilayer enveloping the particle.

In another aspect of the present disclosure, there is provided a method of preparing a durable reconstitutable preparation of particles with a lipid bilayer, comprising providing particles as described herein and freezing said particles, preferably shock-freezing said particles.

Description

It is a goal of the present invention to provide improved model lipid membranes comprising membrane proteins, that allow quick and reliable testing of the activity of said proteins within the membrane environment.

This goal is achieved by the subject matter of the claims. In particular, the present invention provides a nano- or microsized particle comprising membrane proteins immobilized to the surface of the particle and a sheet of a lipid bilayer interspaced between the membrane proteins and enveloping said particle, wherein said membrane protein is immobilized to the surface of the particle by a linker molecule with a length of at most 5.5 nm. The present invention and its preferred embodiments are further defined in the claims. It is noted that various structural components and parameters can be modified as is explained with regard to preferred embodiments in the following wherein of course each of these embodiments can be combined with other preferred embodiments as should be clear to a skilled per-