Translocation of nanoparticles through lipid bilayer of vesicles by cryo-electron tomography

Meriem Er-Rafik[1,3], Marc Schmutz[1], Tapas Paira[2], Olivier Sandre[2], Jean-Francois Le Meins[2], Carlos M. Marques[1]

[1]*Institut Charles Sadron, Université de Strasbourg-CNRS, 67034 Strasbourg, France*

[2]*Laboratoire de Chimie des Polymères Organiques (LCPO), Université de Bordeaux, CNRS, 33607 Pessac, France*

e-mail: meriem.er-rafik@ics-cnrs.unistra.fr

Abstract

Innumerous molecules, molecular aggregates and particles, from simply water to complex proteins or self-assembled small liposomal carriers, can frequently cross the cell membrane. According to the size and nature of the crossing species, the cell membrane plays an important role as an active or passive sieve controlling or facilitating the translocation of molecules. Despite a constant increase of the variety of new particles or molecular assemblies that can potentially interact with the plasma membrane, due to rapid progress in nanotechnology, the molecular features determining how permeable a membrane is with respect to a given molecule or nanoparticle are not yet elucidated.

Here, we will introduce cryo-electron tomography as a relevant technique to investigate the translocation of the nanoparticles through the lipid bilayer of liposomes. Cryo-electronic microscopy allows not only to inspect the structure of the membrane, by resolving for instance the two leaftlets of the bilayer, but reveals also composition and geometric features of nanoparticles such as size, shape and density that play an important role for the translocation through the lipid bilayer. The tomographic projections of cryo-electron tomography resolve in 3D space the relative positions of particles and membranes, providing insight into the interplay between particle-lipid interactions and the ensuing bilayer transformations.