Hybrid Vesicles with Applications in Biotechnology and Nanomedicine

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Abstract

The chemical complexity of biological cells is facilitated by their highly compartmentalised architecture, separating function and chemically incompatible processes into distinct, spatially segregated regions bound by biomembranes. This has inspired the use of lipid vesicles in soft nanotechnology as containers that isolate and protect their contents from the bulk medium, with applications including cargo transport and nanoscale reaction vessels. Mimicking lipid self-assembly, amphiphilic block copolymers are now well-established to be able to form vesicles with the advantageous properties including enhanced mechanical stability and greater diversity of chemical functionality. However lipids are still attractive vesicle components due to their natural biocompatibility. This has led to recent research efforts in the assembly and characterisation of hybrid lipid – block copolymer vesicles that combine the advantageous properties of both of these materials.

Despite this rationale behind creation of hybrid vesicles, a little further thought suggests that this idea might not be viable. Major structural incompatibilities between the unitary systems would seem to make stable blends of lipids and block copolymers unlikely. Lipids form fairly well-ordered lyotropic bilayer films, whereas block copolymers form interdigitated polymer melts that often do not match the hydrophobic thickness of lipid bilayers. However, despite these incompatibilities, stable hybrid vesicles can be generated. I will discuss some of the properties of these hybrid vesicles and our work towards applications in sustained release drug delivery formulations and functional reconstitution of membrane proteins in bio(nano)technology.