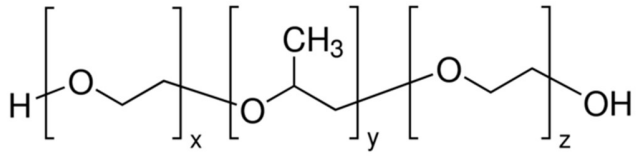
Patent Claims

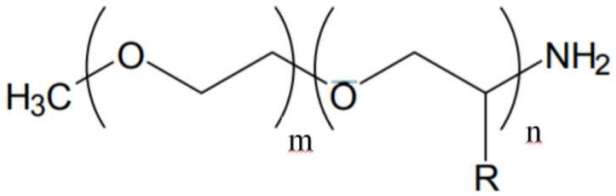
1. A vesicle incorporating a transmembrane protein, wherein the vesicle forming material comprises a mixture of poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) and polyetheramine.
2. The vesicle according to claim 1, wherein the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) is a substantially linear polymer having an average molecular weight of between about 1,000 Da to about 15,000 Da.
3. The vesicle according to claim 1 or 2, wherein the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) has the chemical formula:



in which

x denotes an integer between 10-30
y denotes an integer between 50-100
z denotes an integer between 10-30.

4. The vesicle according to anyone of the claims 1 to 3, wherein the polyetheramine is of the general structure



in which
m is an integer of 1-15
n is an integer of 5-50
R = CH_3.

5. The vesicle according to anyone of the claims 1 to 4, wherein the proportion by weight between the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) and the polyetheramine is 5 to 1.

6. The vesicle according to anyone of the claims 1 to 5, wherein the transmembrane protein is an aquaporin water channel.

7. A method of preparing vesicles incorporating a transmembrane protein comprising the steps of

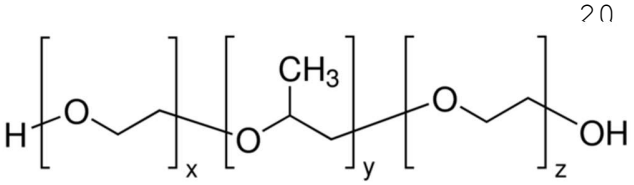
a. mixing an aqueous solution of transmembrane protein and polyetheramine,

b. adding poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) as an aqueous solution to the mixture prepared step a,

c. agitating the solution obtained in step b.

8. The method according to claim 7, wherein the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) is a substantially linear polymer having an average molecular weight of between about 1,000 Da to about 15,000 Da.

9. The method according to claim 7 or 8, wherein the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) has the chemical formula:



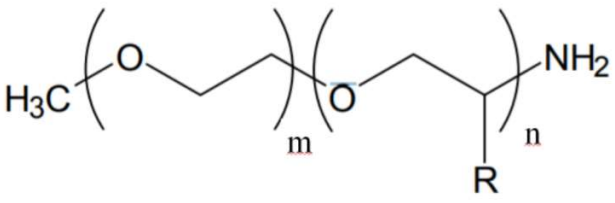
in which

x denotes an integer between 10-30

y denotes an integer between 50-100

z denotes an integer between 10-30.

10. The method according to anyone of the claims 7 to 9, wherein the polyetheramine is of the general structure



in which

m is an integer of 1-15

n is an integer of 5-50

R = CH_3.

11. The method according to anyone of the claims 7 to 10, wherein the proportion by weight between the poly(ethylene glycol)-*block*-poly(propylene glycol)-*block*-poly(ethylene glycol) and the polyetheramine is 5 to 1.
12. The method according to anyone of the claims 7 to 11, wherein the transmembrane protein is an aquaporin water channel.
13. A separation membrane comprising a vesicle according to any one of claims 1-6.
14. The separation membrane according to claim 13, comprising an active layer incorporating the vesicle and a porous support membrane, said active layer comprising the vesicle incorporated in a thin film composite layer formed on the porous substrate membrane.
15. A method of preparing a thin film composite layer immobilizing vesicles incorporating a transmembrane protein on a porous substrate membrane, comprising the steps of
    a. Providing an aqueous solution comprising the vesicles prepared in accordance with any of the claims 7 to 12 and a di-amine or tri-amine compound,
    b. Covering the surface of a porous support membrane with the aqueous solution of step a,
    c. Applying a hydrophobic solution comprising an acyl halide compound, and
    d. Allowing the aqueous solution and the hydrophobic solution to perform an interfacial polymerization reaction to form the thin film composite layer.
16. The method according to claim 15, wherein the porous support membrane is formed by a polysulfone or a polyethersulfone polymer.
17. The method according to claim 15 or 16, wherein the porous support membrane is a hollow fiber.
18. The method according to claim 17, comprising the further step of producing a hollow fiber module by assembling a bundle of hollow fibers in a housing, wherein an inlet for passing a first solution is connected to the lumen of the hollow fibers in one end and an outlet is

connected to the lumen in the other end, and an inlet is provided in the housing for passing a second solution to an outlet connected to the housing.

19. The method according to claim 15 or 16, wherein the porous support membrane is a flat sheet.

20. The method according to claim 19, comprising the further step of producing a spiral wound membrane module by winding the flat sheet membrane.