CLAIMS

1. A method of making a membrane, the method comprising:

coupling a vesicle to a support substrate, the vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

partially embedding the vesicle coupled to the support substrate in a layer of material that is substantially impermeable to water to form the membrane,

wherein the layer of material that is substantially impermeable to water comprises a polymer layer and the step of partially embedding the vesicle coupled to the support substrate in the polymer layer comprises:

providing a solution of monomers on the porous substrate to partially immerse the coupled vesicle in said solution; and

polymerizing the monomers to form a layer of polymer such that the vesicle is partially embedded therein.

2. A method of making a membrane, the method comprising:

coupling a vesicle to a support substrate, the vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

partially embedding the vesicle coupled to the support substrate in a layer of material that is substantially impermeable to water to form the membrane,

wherein the step of coupling the vesicle to the support substrate comprises reacting a first surface functional group of the vesicle with a second surface functional group of the support substrate to form a covalent bond.

3. A method of making a membrane, the method comprising:

coupling a vesicle to a support substrate, the vesicle comprising a plurality of water channels thereon; and

partially embedding the vesicle coupled to the support substrate in a layer of material that is substantially impermeable to water to form the membrane,

wherein the water channels comprise aquaporin water channels.

10. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein the water channels are selectively permeable to allow water to pass through but substantially prevent one or more types of solutes from passing through, wherein the solutes comprises one or more ions selected from the group consisting of sodium, calcium, magnesium, potassium, borate, chloride, sulfate, bicarbonate, bromide, strontium, fluoride, and mixtures thereof.

11. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein the water channels comprise aquaporin water channels.

12. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein each of the vesicles comprises an amphiphilic membrane selected from the group consisting of a polymer, a lipid or mixtures thereof.

13. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein the layer of material that is substantially impermeable to water has a thickness that is less than the average diameter of the vesicles.

14. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein the layer of material that is substantially impermeable to water has a porosity of no more than about 30%.

15. A membrane for water filtration, the membrane comprising:

a support substrate;

a plurality of vesicles coupled to the support substrate, each vesicle comprising an amphiphilic membrane and a plurality of water channels thereon; and

a layer of material disposed over the support substrate that partially encapsulates the plurality of vesicles, wherein said layer of material is substantially impermeable to water,

wherein the membrane has a sodium chloride rejection percentage from 20 % to 99.9 % when said membrane is used to separate sodium chloride from a feed solution comprising the sodium chloride, and wherein the sodium chloride rejection percentage is calculated by the formula,

$$Sodium_Chloride_rejection = \left(1 - \frac{\left(C_{f0}V_{f0} - C_{f1}V_{f1}\right)/(\Delta W_d / D_W)}{C_{f0}}\right) \times 100\%$$

where C_{f0} is a initial sodium chloride concentration of the feed solution (g/L); V_{f0} is a initial volume of the feed solution (L); C_{f1} is a final sodium chloride