Claims

1. A composition for TIPS membranes comprising

30 to 50% PVDF,

15 to 25% fine powder extractable filler having an average particle sizes of between 1 to 250 nm,

35 to 55% organic latent solvent, and

0 to 10% additives,

wherein the PVDF has a heat of melting Delta H of from 45 to 55 J/gm on the second heat D3418 (DSC), and the percent of reverse units by NMR is from 4.6 to 5.8.

2. The composition of claim 1 wherein the PVDF powder has a melting point of between 160 to 170 C on second heat.

3. The composition of claim 1 or 2 wherein the PVDF powder comprises from 30 to 45 wt percent of the composition and the organic latent solvent comprises from 35 to 42 wt percent of the composition.

4. The composition of any one of claims 1 to 3 wherein the PVDF is a homopolymer or copolymer comprising at least 95 weight% vinylidene fluoride.

5. The composition of any one of claims 1 to 4 wherein the fine powder extractable filler is selected from the group consisting of including fumed silica, zinc oxide, aluminum oxide, zirconium oxide, iron oxide, calcium carbonate, and combination thereof.

6. The composition of any one of claims 1 to 5 wherein the latent solvent is selected from the group consisting of Diethylphthalate, dibutylphthalate, dibutylsebacate, acetyl-tributylcitrate, tributylcitrate, acetyl-triethylcitrate and combinations thereof.

7. A method for producing a porous membrane comprising the steps of

(i) feeding the composition of any one of claims 1 to 6, preferably in pellet form, to an extruder,

(ii) extruding the melted product to form a structure,

(iii) extracting the solvent from the structure with an organic solvent preferably alcohol,

(iv) extracting the filler with acid or base, and

(v) washing the structure with pure water to produce a porous membrane.

8. A method for producing a porous membrane comprising the steps of

(a) pre-blending fine powder PVDF having a D50 of 3 to 15 micron, fine powder extractable filler having average particle sizes of between 1 to 250 nm and latent solvent to produce a free

flowing powder blend, wherein the free flowing powder blend contains 15 – 30% by weight of a latent solvent,

(b) feeding the free flowing powder blend to an extruder or kneader wherein the free flowing powder blend is melted to produce a melted blend,

(c) feeding an additional aliquot of latent solvent down-stream in the extruder or kneader into the melted blend to produce a melted product,

(d) extruding the melted product to form a structure,

(e) extracting the solvent from the structure with organic solvent, preferably alcohol, and

(f) extracting the filler with acid or base,

to produce a porous membrane.

9. The method of claim 8, wherein the PVDF has a heat of melting Delta H of from 45 to 55 J/gm on the second heat ASTM D3418 (DSC), and the percent of reverse units by NMR is from 4.6 to 5.8.

10. The method of claim 8 or 9, further comprising step (g) of washing the structure with water after step (f).

11. The method of any one of claims 8 to 10, wherein the amount of the additional aliquot of latent solvent is from 5 to 50 wt %, preferably from 7 to 47% by weight based on the total weight of the material prepared in (a).

12. The method of any one of claims 8 to 11, wherein in step (a) the fine powder PVDF and the fine powder extractable filler are first blended together followed by the addition of the latent solvent.

13. The method of any one of claims 8 to 12, further comprising the steps of

(c2) extrude out solid pellets from step (c), and

(c3) feeding the pellets to a second extruder.

14. The method of any one of claims 8 to 13, wherein the structure exiting step (d) extrudes into a water bath.

15. The method of any one of claims 8 to 14, wherein the PVDF is a homopolymer or copolymer comprising at least 95 weight % vinylidene fluoride.

16. The method of any one of claims 8 to 15, wherein the fine powder extractable filler is selected from the group consisting of including fumed silica, zinc oxide, aluminum oxide, zirconium oxide, iron oxide, and calcium carbonate and combination thereof.

17. The method of any one of claims 7 to 15, wherein the fine powder extractable filler comprises fumed silica.

18. The method of any one of claims 7 to 15, wherein the fine powder extractable filler comprises zinc oxide.

19. The method of any one of claims 7 to 18, wherein the latent solvent is selected from the group consisting of dimethyl phthalate, diethylphthalate, dibutylphthalate, dioctylphthalate, diethylhexylphthalate, dibutylsebacate, triethylcitrate, acetyl- triethylcitrate, tributylcitrate, acetyl-tributylcitrate, glycerol triacetate (Triacetin), glycerol tributyrate (Tributyrin), propylene carbonate, diphenylcarbonate, butyllevulinate, n-octylpyrrolidone, benzoic acid esters such as methyl benzoate and ethyl benzoate, phosphoric acid esters such as triphenyl phosphate, tributyl-phosphate, and tricresyl phosphate , dimethyl succinate, diethyl succinate, gamma valerolactone, and mixtures thereof.

20. The method of any one of claims 8 to 18, wherein the latent solvent is selected from the group consisting of Diethylphthalate, dibutylphthalate, dibutylsebacate, acetyl-tributylcitrate, tributylcitrate, acetyl-triethylcitrate, triethylcitrate, and combinations thereof.

21. A membrane made by the method of claim 7 where the membrane has a flowrate of at least 800 lmhb and a tensile strength of at least 8 MPa, preferably at least 1000 lmbh and at least 10 MPa.

22. A membrane made by the method of any one of claims 8 to 20 where the membrane has a flowrate of at least 800 lmhb and a tensile strength of at least 8 MPa, preferably at least 1000 lmbh and at least 10 MPa.