

CLAIMS:

1. A method of manufacturing an an-ion exchange membrane, the method comprising:
 - purifying a thermoplastic elastomer (TPE) comprising an aromatic ring,
 - halomethylating the purified TPE, and
 - casting of the membrane,
 - aminating the purified and halomethylated TPE with at least a first amine and a second amine, the amines being any two or more of:
 - a monoamine,
 - a diamine, and
 - a polyamine, and
 - preparing the resultant membrane for use or storage.
2. A method according to claim 1, wherein the TPE is a polymeric backbone, and the method includes cross-linking of a polymeric backbone to one or more other polymeric backbones and/or a side chain of a said polymeric backbone.
3. A method according to claim 2, wherein said cross-linking occurs during, or immediately after, said casting step.
4. A method according to claim 2 or claim 3, wherein said cross-linking occurs during said amination step.
5. A method according to any of claims 1 to 4, wherein the first and second amines are TMHDA and TMA respectively.
6. A method according to any of claims 1 to 5, wherein the first and second amines are any two of:
 - N-methylimidazole,
 - N-methylpiperidine,
 - N-Methylpyrrolidine,
 - Triethanolamine
 - DABCO,
 - TMEDA,
 - TMHDA, and

- TMA.
7. A method according to any of the preceding claims, wherein halomethylation involves:
 - dissolving the purified TPE,
 - mixing the dissolved TPE with any of trioxane, trimethylsilyl chloride and SnCl_4 ,
 - placing the reactants in a reflux condenser, and
 - heating from 0°C to 50°C for an extended period between 3 hours and 6 days.
 8. A method according to any of the preceding claims, wherein the membrane is cast with means adapted to control the rate of evaporation of the solvent.
 9. A method according to any of the preceding claims, wherein the membrane is cast by heating and extruding then purified chloromethylated polymer or by roll to roll.
 10. A method according to any of the preceding claims, wherein one or more of the amines selected have a carbon chain of three or more.
 11. A method according to claim 2, wherein a ratio of said first amine to said second amine is predetermined to determine cross-linking.
 12. A method according to any of the preceding claims, wherein any one of, or combination of, the following fillers are present: Al_2O_3 , SnO_2 , Cu phthalocyanine, Vulcan, and montmorillonite.
 13. A method according to any of the preceding claims, wherein a, or each of two or more steps, is undertaken in an environment controlled for any of the following:
 - light,
 - cleanliness,
 - humidity, and
 - inert atmosphere.
 14. An an-ion exchange membrane manufactured by the method according to any of the preceding claims.
 15. An an-ion exchange membrane according to claim 14, comprising one or more cationic groups wherein the functionalisation degree is between 1% and 50%.
 16. An an-ion exchange membrane comprising a thermoplastic elastomer (TPE) comprising an aromatic ring, said TPE being a polymeric backbone, wherein the styrene content of the TPE is between 30wt% and 70wt%, and wherein a first polymeric backbone is cross-linked to one or more polymeric backbones and/or side chain(s) of a polymeric backbone, the an-ion exchange

membrane further comprising one or more cationic groups, wherein the functionalisation degree is between 1% and 50%.

17. An an-ion exchange membrane according to claim 15 or claim 16, wherein the functionalisation degree is in the range 3% to 35%.
18. An an-ion exchange membrane according to any of claims 15 to 17, wherein the one or more cationic groups comprise nitrogen, phosphorous, sulphur and/or a metal ion.
19. An an-ion exchange membrane manufactured by a method of claim 2 or claim 11, wherein a first polymeric backbone is cross-linked to a side chain including a cationic group.
20. An an-ion exchange membrane according to any of claims 14 to 19, wherein the styrene content of the TPE is in the range 35wt% to 55wt%.
21. An an-ion exchange membrane according to any of claims 14 to 20, having a thickness between 10 and 100µm.
22. An an-ion exchange membrane according to any of claims 14 to 21, utilised in a membrane electrode assembly in any one of:
 - electrolyser,
 - fuel cell,
 - electrochemical compressor, and
 - electroosmotic device.
23. A membrane electrode assembly including an an-ion exchange membrane according to any of claims 14 to 21.