Claims

1. A method for forming a graphene oxide/polymer composite membrane, wherein graphene oxide is embedded in the polymer matrix, the method comprising:

   (a) providing a container containing concentrated sulfuric acid and placing the container in an ice bath;

   (b) adding graphite nanofibers to the container of (a);

   (c) adding potassium permanganate to the container of (b);

   (d) removing the container of (c) from the ice bath;

   (e) adding hydrogen peroxide to the container of (d);

   (f) filtering the mixture of (e) to obtain a filter cake;

   (g) dispersing the filter cake of (f) in water and drying the dispersion to obtain graphite oxide nanofibers;

   (h) adding the graphite oxide nanofibers of (g) to a solvent to obtain a hydrosol mixture and sonicating the hydrosol mixture;

   (i) adding the hydrosol mixture of (h) to a polymer dope solution; and

   (j) casting the polymer dope solution of (i) by wet phase inversion technique to form the graphene oxide/polymer composite membrane.

2. The method of claim 1, wherein in steps (a), (b), and (c), the temperature of mixture in the container is maintained at 35 °C and below.

3. The method of claim 1 or 2, wherein the composite membrane comprises up to 3 wt% of graphene oxide embedded in the polymer matrix.

4. The method of claim 3, wherein the composite membrane comprises up to 1 wt% of graphene oxide embedded in the polymer matrix.

5. The method of claim 4, wherein the composite membrane comprises about 0.5 wt% of graphene oxide embedded in the polymer matrix.

6. The method of any one of claims 1 to 5, wherein the solvent of (h) is 1-methyl-2-pyrrolidone (NMP) or N,N-dimethylacetamide (DMAc).

7. The method of any one of claim 1 to 6, wherein in step (b) adding graphite nanofibers to the container of (a) comprises adding sodium nitrate simultaneously with the graphite nanofibers.

8. A method for forming a graphene oxide/polymer composite membrane, wherein graphene oxide is embedded in the polymer matrix, the method comprising:

(a) providing a container containing a mixture of concentrated sulphuric acid and concentrated phosphoric acid;

(b) adding graphite nanofibers to the container of (a);

(c) adding potassium permanganate to the container of (b);

(d) adding hydrogen peroxide to the container of (c);

(e) filtering the mixture of (d) to obtain a filter cake;

(f) dispersing the filter cake of (e) in water and drying the dispersion to obtain graphite oxide nanofibers;

(g) adding the graphite oxide nanofibers of (f) to a solvent to obtain a hydrosol mixture and sonicating the hydrosol mixture;

(h) adding the hydrosol mixture of (g) to a polymer dope solution; and

(i) casting the polymer dope solution of (h) by wet phase inversion technique to form the graphene oxide/polymer composite membrane.

9. The method of claim 8, wherein the composite membrane comprises up to 3 wt% of graphene oxide embedded in the polymer matrix.

10. The method of claim 9, wherein the composite membrane comprises up to 1 wt% of graphene oxide embedded in the polymer matrix.

11. The method of claim 10, wherein the composite membrane comprises about 0.5 wt% of graphene oxide embedded in the polymer matrix.

12. The method of any one of claims 8 to 11, wherein the solvent of (g) is 1-methyl-2-pyrrolidone (NMP) or N,N-dimethylacetamide (DMAc).

13. A method for forming a graphene oxide/polymer composite membrane, wherein graphene oxide is embedded in the polymer matrix, the method comprising:

(a) providing a container containing concentrated sulphuric acid and placing the container in an ice bath at about 0 °C;

(b) adding graphite nanofibers to the container of (a);

(c) adding a first amount of potassium permanganate to the container of (b) and keeping the temperature of the mixture in the container at about 10 °C or below;

(d) adding a second amount of potassium permanganate to the container of (c);

(e) removing the container of (d) from the ice bath;

(f) adding hydrogen peroxide to the container of (e);

(g) filtering the mixture of (f) to obtain a filter cake;

(h) dispersing the filter cake of (g) in water and drying the dispersion to obtain graphite oxide nanofibers;

(i) adding the graphite oxide nanofibers of (h) to a solvent to obtain a hydrosol mixture and sonicating the hydrosol mixture;

(j) adding the hydrosol mixture of (i) to a polymer dope solution; and

(k) casting the polymer dope solution of (j) by wet phase inversion technique to form the graphene oxide/polymer composite membrane.

14. The method of claim 13, wherein the composite membrane comprises up to 3 wt% of graphene oxide embedded in the polymer matrix.

15. The method of claim 14, wherein the composite membrane comprises up to 1 wt% of graphene oxide embedded in the polymer matrix.

16. The method of claim 15, wherein the composite membrane comprises about 0.5 wt% of graphene oxide embedded in the polymer matrix.

17. The method of any one of claims 13 to 16, wherein the solvent of (i) is 1-methyl-2-pyrrolidone (NMP) or N,N-dimethylacetamide (DMAc).

18. A graphene oxide/polymer composite membrane comprising graphene oxide embedded in the polymer matrix, wherein the graphene oxide exists in a form of sheets exfoliated from graphite oxide nanofibers.

19. The composite membrane of claim 18, wherein the polymer is polysulfone or polyethersulfone.

20. The composite membrane of claim 18 or 19, wherein the X-ray diffraction peak of the graphene oxide to be embedded in the polymer matrix at 2θ is $2°$.