## CLAIMS

1. A method of producing a silicalite membrane, the method comprising:

heating an aqueous solution comprising a dopant precursor and structure-directing template agents to form silicalite seeds incorporated with a dopant;

depositing a buffer layer on a ceramic substrate prior to depositing the silicalite seeds on the buffer layer;

sealing both ends of the ceramic substrate prior to depositing the buffer layer on the ceramic substrate, wherein the ceramic substrate has a tubular configuration;

contacting the ceramic substrate with a solution comprising the silicalite seeds to form a silicalite layer from the silicalite seeds on the ceramic substrate; and

removing the structure-directing template agents to form the silicalite membrane, wherein the silicalite layer comprises silicalite crystals incorporated with a dopant and each of the silicalite crystals has a hollow structure which forms the pores of the silicalite layer.

2. The method of claim 1, wherein heating the aqueous solution comprises mixing the structure-directing template agents in water, wherein the structure-directing template agents comprise tetrapropylammonium hydroxide and tetraethyl orthosilicate.

3. The method of claim 1, wherein heating the aqueous solution comprises:

mixing the dopant precursor and the structure-directing template agents to form the aqueous solution; and

subjecting the aqueous solution to hydrothermal treatment at a temperature of 100ºC to 200ºC to form the silicalite seeds and then cooling the aqueous solution comprising the silicalite seeds.

4. The method of claim 1, wherein the dopant precursor comprises cerium nitrate hexahydrate, boric acid, tin chloride pentahydrate, cobalt (II) nitrate hexahydrate, sodium aluminate, gallium trichloride, indium acetate, yttrium trichloride, or a mixture thereof.

5. The method of claim 1, further comprising:

centrifuging the aqueous solution comprising the silicalite seeds to retrieve the silicalite seeds;

adding water to the silicalite seeds;

repeating the centrifuging and the adding of water until a liquid suspension comprising the silicalite seeds and having a pH of 7 to 8 is attained;

drying the liquid suspension; and

grinding the silicalite seeds and then calcinating the silicalite seeds at 500ºC to 600ºC.

6. The method of claim 1, wherein depositing the buffer layer comprises:

heating an acidic solution comprising tetraethyl orthosilicate and an alcohol and then cooling the acidic solution;

mixing a surfactant with an extract of the acidic solution, wherein the surfactant comprises hexadecyltrimethylammonium bromide; and

heating the surfactant and the extract of acidic solution to form a buffer layer solution.

7. The method of claim 1, wherein the ceramic substrate comprises zeolite, aluminum oxide, titanium oxide, zirconium oxide, or a mixture thereof.

8. The method of claim 1, wherein depositing the buffer layer comprises:

immersing the ceramic substrate in the buffer layer solution;

removing the ceramic substrate at a speed of 1 mm/s to 5 mm/s from the buffer layer solution; and

calcinating the ceramic substrate having the buffer layer solution thereon at 400ºC to 600ºC to have the buffer layer deposited on the ceramic substrate.

9. The method of claim 8, wherein immersing the ceramic substrate in the buffer layer solution comprises immersing the ceramic substrate in the buffer layer solution for at least 1 minute.

10. The method of claim 1, wherein contacting the ceramic substrate with the solution comprising the silicalite seeds comprises:

sealing both ends of the ceramic substrate having the buffer layer deposited thereon;

immersing the ceramic substrate having the buffer layer deposited thereon in the solution comprising the silicalite seeds;

removing the ceramic substrate having the buffer layer deposited thereon from the solution comprising the silicalite seeds at a speed of 1 mm/s to 5 mm/s;

drying the ceramic substrate having the silicalite seeds deposited thereon; and

repeating the immersing, the removing and the drying steps one or more times.

11. The method of claim 10, wherein immersing the ceramic substrate having the buffer layer deposited thereon in the solution comprising the silicalite seeds comprises immersing the ceramic substrate having the buffer layer deposited thereon in the solution comprising the silicalite seeds for at least 1 minute.

12. The method of claim 1, further comprising:

providing a growth solution comprising silicalite seeds;

immersing the ceramic substrate having the silicalite seeds deposited thereon in the growth solution; and

subjecting the ceramic substrate immersed in the growth solution to hydrothermal treatment at a temperature of 100ºC to 200ºC to grow the silicalite seeds on the ceramic substrate.

13. The method of claim 12, wherein providing the growth solution comprises mixing tetrapropylammonium hydroxide and tetraethyl orthosilicate with the dopant precursor in water to form the growth solution.

14. The method of claim 1, wherein removing the structure-directing template agents comprises calcinating the ceramic substrate having the silicalite seeds deposited thereon at a temperature of 500ºC to 600ºC.

15. A silicalite membrane produced according to the method of any one of claims 1 to 14, wherein the silicalite membrane comprises:

the ceramic substrate having the buffer layer formed only on an outer surface of the ceramic substrate, wherein the ceramic substrate has the tubular configuration; and

the silicalite layer formed on the buffer layer, wherein the silicalite layer comprises the silicalite crystals incorporated with the dopant and each of the silicalite crystals has the hollow structure which forms the pores of the silicalite layer.

16. The silicalite membrane of claim 15, wherein the dopant comprises cerium, boron, tin, cobalt, aluminum, gallium, indium, yttrium, or a mixture thereof.

17. The silicalite membrane of claim 15, wherein the buffer layer comprises pores having an average size larger than the average size of pores of the silicalite layer but smaller than the average size of pores of the ceramic substrate.

18. The silicalite membrane of claim 15, wherein the ceramic substrate comprises zeolite, aluminium oxide, titanium oxide, zirconium oxide, or a mixture thereof.