CLAIMS:

1. A filter configured to allow communication of substances from one side to another side, and configured to separate substances passing therethrough, comprising:

a mechanically stable porous substrate;

a solid material in contact with the porous substrate, the solid material defining a skin having at least one channel, each channel having at least one entrance at a surface of the skin and at least one exit at a pore of the porous substrate;

wherein the entrance of each channel has a diameter which is 3 nm or less, and

wherein the at least one channel is comprised of one or more tubular structures comprised of a stack of macrocycles having a first internal diameter which are coaxially associated and that are at least partially embedded within the solid material.

2. The filter of claim 1, wherein the macrocycles are embedded in the solid material in a manner that excludes passage between the macrocycles and solid material of materials wider than the first internal diameter and preferably, wherein the solid material is adhered to each of the macrocycles in the tubular structure, and even more preferably, wherein the solid material is adhered to each of the macrocycles embedded by the solid material in the tubular structure with a chemical link.,

3. The filter of claim 1, wherein the macrocycles are comprised of cyclodextrins, calixarenes, pillararenes, porphyrins, crown ethers, helical molecules, cubril[n]s, cucubriturils, aspherands, kekulenes, cage molecules, metallic macrocycles, carbon nanotubes, or any combination thereof.

4. The filter of claim 1, wherein at least one channel comprises an asymmetric tubular structure, wherein the asymmetric tubular structure includes at least one macrocycle having a second internal diameter which is narrower than the first internal diameter, wherein one or more of (i) the at least one macrocycle having a second internal diameter is at a tip of the asymmetric tubular structure which is located at the top portion of the at least one channel, such that the tip comprises an entrance of the channel, and optionally, wherein the skin extends to above a height of the tip molecule but does not encase the entrance of the channel; or (ii) wherein the at least one macrocycle having a

second internal diameter is located within the channel or at its bottom, but not at a tip thereof, such that the channel optionally has an hourglass-like configuration; and optionally, wherein the at least one macrocycle having a second molecular diameter is a crown ether.

5. The filter of claim 1, wherein the skin encases a lower portion of the at least one tubular structure and does not encase an upper portion of the at least one tubular structure; wherein the lower portion of the at least one tubular structure comprises macrocycles that are associated with each other in a manner that preserves gaps that are greater than a size of an entrance to the channel; and wherein the upper portion of each tubular structure comprises macrocycles that are associated with each other in a manner that reduces gaps between adjacent macrocycles to below the size of the entrance to the channel.

6. A filter configured to allow communication of substances from one side to another side, and configured to separate substances passing therethrough, comprising:

a mechanically stable porous substrate;

a solid material in contact with the porous substrate, the solid material defining a skin having at least one channel, each channel having at least one entrance at a surface of the skin and at least one exit at a pore of the porous substrate;

wherein the entrance of each channel has a diameter which is 3 nm or less, wherein the at least one channel is comprised of the solid material, with one or more tubular structures comprised of macrocycles overlaid on the solid material.

7. The filter of claim 1 or 6, further comprising at least one elongated molecule inserted within at least a top of an uppermost tubular structure in the channel and chemically associated to the uppermost tubular structure in the channel or to the solid material, or at least one stopper molecule and elongated molecule attached to the at least one stopper and inserted within at least a top of an uppermost tubular structure in the at least one channel, such that the uppermost tubular structure and the at least one elongated molecule and optionally the at least one stopper molecule define a second internal diameter, wherein the second internal diameter is narrower than the first internal diameter and comprises an entrance to the channel.

8. The filter of claim 1 or 6, wherein the entrance of at least one channel is blocked due to at least one of the following:

a) a stopper molecule and elongated molecule attached to the at least one stopper and inserted within a top of an uppermost tubular structure in the channel;

b) an elongated molecule attached to the solid material and inserted within a top of an uppermost tubular structure in the channel; and

c) deposition of solid material in a manner that buries the top of an uppermost tubular structure in the channel;

and wherein a passage between adjacent macrocycles at an outer shell of the at least one tubular structure defines a second internal diameter, wherein the second internal diameter is narrower than the first internal diameter and comprises an entrance to the channel.

9. A filter configured to allow communication of substances from one side to another side, and configured to separate substances passing therethrough, comprising:

a mechanically stable porous substrate;

a solid material in contact with the porous substrate, the solid material defining a skin having at least two pores;

wherein the diameter of each pore in the skin is less than 4.5 angstroms, and optionally, wherein each pore in the skin has a substantially uniform diameter.

10. A nanoporous surface having at least two nanopores having different pore diameters, wherein at least the entrance of at least one pore is blocked due to at least one of the following:

a) an elongated molecule is inserted within at least the top of at least one pore, said elongated molecule having a tip attached to the nanoporous surface and/or a stopper;
b) a stopper is placed in proximity to the top of at least one pore; and
c) a solid material is deposited in a manner that buries at least the top of at least one pore.

11. A device formed from the following process:

attaching to a surface a plurality of structures, said structures comprising tubular structures, stacks of macrocycles, branched molecules, dendrons, dendrimers, rigid or semi-rigid sufficiently perpendicular molecules, or stretched flexible molecules;

performing a gap-filling process with solid material between the plurality of structures; and

decomposing the plurality of structures, leaving the solid material without any additional material encased therein.

12. A method of manufacturing a filter, comprising:

building at least one tubular structure over at least one pore of a porous substrate that is filled with a sacrificial pore-filling material, each tubular structure comprised of a coaxial stack of associated macrocycles;

filling gaps between tubular structures with a solid gap-filling material;

and removing the sacrificial pore-filling material from the pores of the porous substrate;

to thereby generate at least one channel in which the solid material defines a skin, an entrance of each channel is at a surface of the skin and an exit of each channel is at a pore of the porous substrate;

wherein the entrance of each channel has a diameter which is 3 nanometers or less.

13. The method of claim 12, further comprising:

threading a template molecule attached to a bulky stopper into an entrance of the at least one channel, to thereby define a passage into the at least one channel based on dimensions of the entrance, of the bulky stopper, and of a portion of the template molecule near the entrance of the at least one channel; or

chemically associating at least one elongated molecule to the uppermost tubular structure of the at least one channel or to the solid material and inserting the at least one elongated molecule into a top portion of an uppermost tubular structure of the at least one channel.

14. The method of claim 12, further comprising blocking the entrance of the at least one channel due to at least one of the following:

a) inserting a stopper molecule and elongated molecule attached to the at least one stopper within a top of an uppermost tubular structure in the channel;
b) inserting an elongated molecule attached to the solid material or a tubular structure within a top of an uppermost tubular structure in the channel; and
c) depositing solid material in a manner that buries the top of an uppermost tubular structure in the channel.

15. The method of claim 12, further comprising forming the tubular structures prior to the building step by forming molecular bridges between macrocycles in solution, wherein at least one of:

(i) the step of forming molecular bridges optionally includes utilizing an inclusion complex with a template molecule;

(ii) the tubular structures formed in solution are asymmetric tubular structures, said asymmetric tubular structures comprising of a coaxial stack of associated macrocycles having a substantially identical internal diameter, and a macrocycle having a second internal diameter, said second internal diameter being narrower than the first internal diameter of the macrocycles of the coaxial stack, and, optionally, wherein the bridges between macrocycles that are adjacent to the tip molecule reduce a gap between said macrocycles to less than the second internal diameter.

16. A method of manufacturing a filter, comprising:

selecting a sacrificial substrate, said sacrificial substrate capable of attachment to organic compounds;

attaching a template molecule to the sacrificial substrate;

building at least one channel onto the sacrificial substrate, each channel comprised of one or more tubular structures comprised of a coaxial stack of associated macrocycles;

filling gaps between the tubular structures by adhering a solid gap-filling material to the sacrificial substrate;

attaching a porous substrate or depositing a porous layer to one of the open ends of the tubular structures or the filler material; and

removing the sacrificial substrate and template molecule;

and, optionally, lengthening the channels by attaching additional tubular structures to the ends of the channels that had previously been associated with the sacrificial substrate.

17. A method of forming a tubular structure comprised of macrocycles connected by molecular bridges in solution, comprising:

optionally, modifying at least one functional group of two or more macrocycles; and

forming at least one molecular bridge between said macrocycles by associating the macrocycles at the modified functional groups, wherein the step of forming molecular bridges includes utilizing an inclusion complex with a template molecule.

18. A method for lengthening at least one coaxial stack of macrocycles arranged in a planar array of a surface comprising said coaxial stacks, comprising: forming an inclusion complex between: a template molecule, the coaxial stack of said array and a tubular structure comprising stacked coaxial macrocycles; associating the coaxial stack of said array and the said tubular structure; and removing the template molecule.