CLAIMS

1. A method of critical point drying a composite material, comprising the steps of:

   a. providing a composite material comprising:

      i. a support member, comprising a plurality of pores extending through the support member; and

      ii. a macroporous cross-linked gel, wherein the macroporous cross-linked gel comprises a polymer formed from a reaction of one or more polymerizable monomers with one or more cross-linkers; the macroporous cross-linked gel is located in the pores of the support member; and said macropores of the macroporous cross-linked gel are smaller than the pores of the support member;

      wherein the composite material is wetted with an aqueous solution;

   b. exchanging the aqueous solution with a polar organic solvent, such that the composite material is wetted with the polar organic solvent;

   c. contacting the composite material with a supercritical fluid at a temperature and a pressure above the critical point of the supercritical fluid, wherein the gaseous and liquid phases are indistinguishable; and the polar organic solvent is miscible with the supercritical fluid; and

   d. reducing the pressure;

   thereby critical point drying the composite material.

2. The method of claim 1, wherein the macroporous cross-linked gel comprises a plurality of ligands that are biological molecules or biological ions.

3. The method of claim 1 or 2, wherein the supercritical fluid is selected from the group consisting of carbon dioxide, water, methane, ethane, propane, ethylene, propylene, methanol, ethanol, acetone, and nitrous oxide.

4. The method of claim 1 or 2, wherein the supercritical fluid is selected from the group consisting of carbon dioxide, methane, ethane, propane, ethylene, propylene, methanol, ethanol, acetone, and nitrous oxide.

5. The method of claim 1 or 2, wherein the supercritical fluid is carbon dioxide.

6. The method of any one of claims 1-5, wherein one or more parameters selected from the group consisting of total amount of supercritical fluid relative to sample volume, number of purge cycles, temperature during contact with the supercritical fluid, the exchange rate with the supercritical fluid, the temperature during the evaporation step, the heating rate, and the rate of the pressure reduction are adjusted.

7. The method of any one of claims 1-6, wherein the polar organic solvent is selected from the group consisting of acetone, acetonitrile, ammonia, t-butanol, n-propanol, ethanol, methanol, and acetic acid.

8. The method of any one of claims 2-7, wherein the biological molecules or biological ions are selected from the group consisting of albumins, lysozyme, viruses, cells, γ-globulins of human and animal origins, immunoglobulins of both human and animal origins, proteins of recombinant or natural origin including, polypeptides of synthetic or natural origin, interleukin-2 and its receptor, enzymes, monoclonal antibodies, antigens, lectins, bacterial immunoglobulin-binding proteins, trypsin and its inhibitor, cytochrome C, myoglobulin, recombinant human interleukin, recombinant fusion protein, Protein A, Protein G, Protein L, Peptide H, nucleic acid derived products, DNA of either synthetic or natural origin, and RNA of either synthetic or natural origin.

9. The method of claim 8, wherein the biological molecules or biological ions are Protein A.

10. The method of any one of claims 1-9, wherein the support member comprises a polymeric material selected from the group consisting of polysulfones, polyethersulfones, polyphenyleneoxides, polycarbonates, polyesters, cellulose, and cellulose derivatives.

11. The method of any one of claims 1-10, wherein the composite material is a membrane.

12. The method of any one of claims 1-11, wherein the composite material is in contact with one or more interleaf layers.

13. The method of claim 12, wherein the one or more interleaf layers are selected from the group consisting of screen, polypropylene, polyethylene, and paper.

14. The method of any one of claims 1-13, wherein the cross-linked gel is a neutral hydrogel, a charged hydrogel, a polyelectrolyte gel, a hydrophobic gel, a neutral gel, or a gel comprising functional groups.

15. The method of any one of claims 1-14, wherein the macroporous cross-linked gel comprises macropores having an average size of about 10 nm to about 3000 nm.

16. The method of any one of claims 1-15, wherein the pores of the support member have an average pore diameter of about 0.1 μm to about 50 μm.