degree of breathability, but are lacking in the necessary durability for its applications.

Thus, there remains a need in the art for porous composites that are inexpensive, widely available, easy to use and attach and has outstanding characteristics of both structural integrity and breathability.

SUMMARY OF THE INVENTION

Porous articles having an expanded fluoropolymer layer and a coherent irregular network of thermoplastic particles attached thereto are described herein.

According to an aspect, there is provided a porous article comprising a porous expanded polytetrafluoroethylene (ePTFE) membrane; a first coherent irregular network comprising particles of at least one thermoplastic fluoropolymer fused together, said first coherent irregular network being attached to one side of said porous ePTFE membrane; and a second coherent irregular network comprising particles of at least one thermoplastic fluoropolymer fused together, said second coherent irregular network being attached to said eTPFE membrane on a side opposing said first coherent irregular network; wherein the coherent irregular network comprises open areas, wherein said coherent irregular network and said ePTFE membrane have an attached area ratio between 0.05 to 0.25, wherein the open areas are defined as areas of porosity in a coherent irregular network that extend completely through the thickness of a material, wherein the attached area ratio is defined as the ratio of a measured length of attached area of an image depicted in a scanning electron micrograph SEM divided by an overall length of an adjacent region shown by the image, and wherein the adjacent region is defined as a region between a permeable layer and an expanded fluoropolymer layer.

In one embodiment of the invention the porous article has the coherent irregular network on both a first and second surface, and in other embodiments the coherent irregular network is only on a first surface. The porous article is permeable and in some embodiments the specific resistance is less than 2400 krayls and greater than 0.24 krayls. The porous article of the present invention is provided in some embodiments as being dimensional stability and having a percent area shrinkage of less than 20% as measure and defined herein. In addition, the porous article in some embodiments is provided with a coherent irregular network having a pattern, such as an embossed, linear, discrete, connected and the like as described herein.

Another embodiment of the invention provides an expanded fluoropolymer in a tube, rod, sheet or membrane form. In one embodiment the expanded fluoropolymer is expanded PTFE.

In one embodiment of the invention, the coherent irregular network is provided with open areas, and in some embodiments these open areas are greater than 50 microns in size. In addition, a coherent irregular network having bridging is provided

in some embodiments. The coherent irregular network is further provided having a thickness greater than 5 micron, or is some embodiments greater than 5 microns but less than 500 microns. In one embodiment of the invention, the coherent irregular network is provided and defined by an Sp value of greater than 35 microns on at least one surface of the porous article. In some embodiments the coherent irregular network is provide having a BET surface area of at least 0.35m^2/g, and in other embodiments between 0.25m^2/g and 5m^2/g.

In some embodiments the coherent irregular network comprises a thermoplastic fluoropolymer, and some of these thermoplastic fluoropolymers are provided having a melt flow index (MFI) of between 0.3g/10min. and 10g/10min. The thermoplastic fluoropolymer used to make the coherent irregular network is in some embodiments, fluorinated ethylene propylene (FEP) and more specifically, in some embodiments, this FEP is provided having an MFI of less than 1.0g/10min.

The coherent irregular network in some embodiments is provide as comprising one or more types of polymer, and in some of these embodiments, the polymers have different size, shape, or melting characteristic, such as melting temperature or MFI.

A free standing film of coherent irregular network is provided having features as described above in various embodiments. Both the free standing film and porous article of the present invention are provided having an oleophobic or hydrophilic treatment is some embodiments. In addition, a support layer affixed to either surface of the porous article or free standing film as per embodiments of the present invention is provided.

BRIEF DESCRIPTION OF THE FIGURES

The foregoing and still other aspects of this invention will become fully apparent, along with various advantages and features of novelty residing in the present embodiments, from study of the following drawings and description of these embodiments. Wherein indicia of reference are shown to match related matter stated in the text, as well as the claims section annexed hereto; and accordingly, a better understanding of the invention and the variant uses is intended, by reference to the figures, which are considered as primarily exemplary and not to be therefore construed as restrictive in nature; wherein:

Fig. 1 is a SEM photomicrograph of the surface of an exemplary embodiment of the porous article.

Fig. 2 is a SEM photomicrograph of a cross-section of an exemplary embodiment of the porous article;

Fig. 3 is a SEM photomicrograph of a cross-section of an exemplary embodiment of the porous article;

embodiment wherein a permeable layer is affixed to either sides of the expanded fluoropolymer, there is an adjacent region on either side of the expanded fluoropolymer.

Free Standing as used herein is defined as a material that has enough mechanical integrity to be handled on its own, free of support or attachment to another material. For example, the free standing material could be placed on an expanded fluoropolymer and attached.

Contiguous as used herein is defined as a surface that is connected throughout in an unbroken sequence.

TEST METHODS

Thermal Dimensional Stability:

A sample of sheet material was cut to 15.2 by 3.8cm and place on a thin aluminum pan, covered loosely with aluminum foil to protect the sample but not restrict it, and then place in an oven preheated to a set temperature of 150C. The pan was removed from the oven after 5 minutes. The pan was allowed to cool and then the sample was removed from the pan and the dimensions were measure. A percent shrinkage was then calculated and these results are reported in Table 10.

Melt Flow Index (MFI)

Powders used to make the coherent irregular network were tested for Melt Flow Index (MFI) following the general teachings of ASTM D1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer. In particular, procedure A was generally followed using a temperature of 372C and a 216Kg load. This is detailed in Section 8 of the ASTM.

This test method covers the determination of the rate of extrusion of molten thermoplastic resins using an extrusion plastometer. After a specified preheating time, resin is extruded through a die with a specified length and orifice diameter under prescribed conditions of temperature,

Claims

1. A porous article comprising

a porous expanded polytetrafluoroethylene (ePTFE) membrane;

a first coherent irregular network comprising particles of at least one thermoplastic fluoropolymer fused together, said first coherent irregular network being attached to one side of said porous ePTFE membrane; and

a second coherent irregular network comprising particles of at least one thermoplastic fluoropolymer fused together, said second coherent irregular network being attached to said eTPFE membrane on a side opposing said first coherent irregular network;

wherein the coherent irregular network comprises open areas,

wherein said coherent irregular network and said ePTFE membrane have an attached area ratio between 0.05 to 0.25,

wherein the open areas are defined as areas of porosity in a coherent irregular network that extend completely through the thickness of a material,

wherein the attached area ratio is defined as the ratio of a measured length of attached area of an image depicted in a scanning electron micrograph SEM divided by an overall length of an adjacent region shown by the image, and

wherein the adjacent region is defined as a region between a permeable layer and an expanded fluoropolymer layer.

2. The porous article of claim 1, wherein the coherent irregular network is affixed to said porous ePTFE membrane at only a portion of the adjacent region.

3. The porous article of claim 1, wherein the coherent irregular network is attached to the porous ePTFE membrane at attached areas, wherein the attached areas are defined as areas where a coherent irregular network is attached to the expanded fluoropolymer layer at only a portion of the adjacent region.

4. The porous article of claim 1, wherein said coherent irregular network further comprises a thermoplastic polymer.