

CERAMIC FOAM PRECURSOR RESIN COMPOSITION

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BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates to foam materials and, more particularly to a ceramic foam. It also relates to a method of producing a ceramic foam comprising the steps of creating a foam from a pre-ceramic resin; and, heating the resultant resin foam for a time and at a temperature which converts the pre-ceramic resin to a ceramic.

2. Background Art

Various foam materials are known in the art. There are flexible foams such as foam rubber and solid foams such as polystyrene foam. There are closed cell foams, such as polystyrene, which do not absorb water and similar liquids and, therefore, float. There are open cell foams, such as foam rubber, which absorb water and, therefore, are more useful as sponges than as floats.

All the various foams known in the prior art are high temperature intolerant. That is, if heated to high temperatures, they lose their structure, melt, burn, and disintegrate. Thus, they are not useful for such applications as, for example, catalytic converter substrates or for structural applications.

Ceramic materials are able to withstand temperatures that most metals cannot tolerate. It would, also, be desirable to have a way of making an open cell ceramic foam, although closed cell foams can be desirable as well.

Wherefore, it is an object of the present invention to provide a foam material and method of making it which is tolerant to high temperatures such as would be encountered in a catalytic converter of an internal combustion engine or for a structural application.

It is another object of the present invention to provide a foam material made of ceramic and a method of producing it.

It is still another object of the present invention to provide an open and/or closed cell foam material made of ceramic and a method of producing it which is particularly useful as a substrate for the catalyst material in an automotive catalytic converter or for structural application.

Other objects and benefits of this invention will become apparent from the description which follows hereinafter when read in conjunction with the drawing figures which accompany it.

SUMMARY OF THE DISCLOSURE

The foregoing objects have been achieved by the method of producing a ceramic foam of the present invention comprising the steps of, creating a foam from a pre-ceramic resin; and, heating the resultant resin foam for a time and at a temperature which converts the pre-ceramic resin to a ceramic.

In the preferred embodiment, the step of creating a foam from a pre-ceramic resin comprises mixing a liquid pre-ceramic resin with a liquid phenolic resin, and allowing the resultant mixture to chemically foam and set while the step of heating the resultant resin foam for a time and at a temperature which converts the pre-ceramic resin to a ceramic comprises heating the resultant resin foam for a

time and at a temperature which converts the pre-ceramic resin to a ceramic and out-gasses the phenolic resin via a post-pyrolysis oxidation treatment.

The method may also include the additional step of mixing an additive material which imparts desired qualities to the resultant ceramic foam as part of the step of mixing a liquid pre-ceramic resin with a liquid phenolic resin. This may involve mixing carbon fibers with the liquid pre-ceramic resin with a liquid phenolic resin to make the resultant ceramic foam electrically conductive or mixing iron-based particles, for example, with the liquid pre-ceramic resin and liquid phenolic resin to make the resultant ceramic foam magnetic.

For strength of the resultant ceramic foam, the step of mixing a liquid pre-ceramic resin with a liquid phenolic resin comprises mixing at least 50% of the liquid pre-ceramic resin with the phenolic resin by weight. Superior strength is achieved by mixing at least 70% of the liquid pre-ceramic resin with the phenolic resin by weight.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified functional diagram of the steps of the present invention in one approach to producing a ceramic foam according to the present invention.

FIG. 2 is a simplified cross section through a piece of the foam material produced by the present invention in its resin state before the resin has been converted to a ceramic.

FIG. 3 is a simplified cross section through a piece of the foam material produced by the present invention in after the resin has been converted to a ceramic and showing how non-ceramic components are outgassed and the pores enlarged by the heating process.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As depicted in FIG. 1, the ceramic foam of the present invention is produced by mixing a liquid pre-ceramic resin **10** with a liquid phenolic resin **12**. The mixture then self-foams to form an open and/or closed cell foam **14** which is a combination of the pre-ceramic resin **10** and the phenolic resin **12**. The producing of a foam by such chemical process and the methods of accomplishing it are well known to those of ordinary skill in the art and, per se, form no part of the present invention. The point of novelty of this invention is the components employed and their ultimate conversion to a ceramic foam. Once the foam **14** has formed and set up via a low temperature cure (130° F.), it is moved to an oven **16** where it is heated at a series of times and temperatures as specified by the manufacturer of the liquid pre-ceramic resin **10** for converting the resin **10** to a ceramic.

In tested embodiments of the present invention, the preferred pre-ceramic resin **10** is one sold under the tradename Blackglas 489D by Allied-Signal Corporation. It has a viscosity close to that of water and, therefore, combines easily. Similarly, any of several phenolic resins can be used, but those made by the Crest Company have been used in the tested embodiments and are, therefore, preferred.

As depicted in the simplified drawing of FIG. 2, the foam **14** prior to heating is a mixture of the two resins **10**, **12** and contains open and/or closed cell pores **18**. While not shown in the drawing pictures in the interest of simplicity, the pores **18** may actually be interconnected since it can be an open cell structure. As depicted in FIG. 3, non-ceramic components **20** are out-gassed during the heating process which converts the pre-ceramic resin **10** to a ceramic foam **14**. In