

3-aminopropyltrimethoxysilane, diglycidyletherbisphenol, 3-glycidylpropyltrimethoxysilane, tetrabromobisphenol-A-dimethacrylate, polyactide, polyglycolide, 1,6-hexamethylene dimethacrylate, 1,10-decamethylene dimethacrylate, benzyl methacrylate, butanediol monoacrylate, 1,3-butanediol diacrylate (1,3-butylene glycol diacrylate), 1,3-butylene glycol dimethacrylate, 1,4-butanediol diacrylate, 1,4-butanediol dimethacrylate, n-butyl acrylate, n-butyl methacrylate, t-butyl acrylate, t-butyl methacrylate, n-butyl vinyl ether, t-butylaminoethyl methacrylate, 1,3-butylene glycol diacrylate, cyclohexyl acrylate, cyclohexyl methacrylate, n-decyl acrylate, n-decyl methacrylate, diethylene glycol diacrylate, diethylene glycol dimethacrylate, dipentaerythritol monohydroxypentaacrylate, 2-ethoxyethoxyethyl acrylate, 2-ethoxyethyl methacrylate, ethoxylated bisphenol A diacrylate, ethoxylated bisphenol A dimethacrylate, ethoxylated trimethylolpropane triacrylate, ethyl methacrylate, ethylene glycol dimethacrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, furfuryl methacrylate, glyceryl propoxy triacrylate, 1,6 hexanediol diacrylate, 1,6 hexanediol dimethacrylate, n-hexyl acrylate, n-hexyl methacrylate, 4-hydroxybutyl acrylate, (butanediol monoacrylate), 2-hydroxyethyl acrylate, hydroxyethyl methacrylate, hydroxypropyl acrylate, hydroxypropyl methacrylate, isobornyl acrylate, isobornyl methacrylate, isobutyl acrylate, isobutyl methacrylate, isobutyl vinyl ether, isodecyl acrylate, isodecyl methacrylate, isoocetyl acrylate, isopropyl methacrylate, lauryl acrylate, lauryl methacrylate, maleic anhydride, methacrylic anhydride, 2-methoxyethyl acrylate, methyl methacrylate, neopentyl acrylate, neopentyl methacrylate, neopentyl glycol diacrylate, neopentyl glycol dimethacrylate, n-octadecyl acrylate, (stearyl acrylate), n-octadecyl methacrylate, (stearyl methacrylate), n-octyl acrylate, pentaerythritol tetraacrylate, pentaerythritol triacrylate, 2-phenoxyethyl acrylate, 2-phenoxyethyl methacrylate, 2-phenylethyl methacrylate, phenyl methacrylate, polybutadiene diacrylate oligomer, polyethylene glycol 200 diacrylate, polyethylene glycol 400 diacrylate, polyethylene glycol 200 dimethacrylate, polyethylene glycol 400 dimethacrylate, polyethylene glycol 600 dimethacrylate, polypropylene glycol monomethacrylate, propoxylated neopentyl glycol diacrylate, stearyl acrylate, stearyl methacrylate, 2-sulfoethyl methacrylate, tetraethylene glycol diacrylate, tetraethylene glycol dimethacrylate, tetrahydrofurfuryl acrylate, tetrahydrofurfuryl methacrylate, n-tridecyl methacrylate, triethylene glycol diacrylate, triethylene glycol dimethacrylate, trimethylolpropane triacrylate, trimethylolpropane trimethacrylate, 3-methacryloxypropyltrimethoxysilane, trimethylsilylmethacrylate, (trimethylsilylmethyl) methacrylate, tripropylene glycol diacrylate, tris(2-hydroxyethyl)isocyanurate triacrylate, vinyl acetate, vinyl caprolactam, n-vinyl-2-pyrrolidone, zinc diacrylate and zinc dimethacrylate.

Another embodiment of the present invention substitutes a prepolymer or oligomer for some of the monomer used. The oligomers used are miscible with the monomers mentioned above. Preferably the oligomers are formed from one or more of the same monomers employed in the monomer system.

Additives to the pre-ceramic inorganic or organic precursors can include lithium, potassium, calcium, aluminum, alkali or alkaline earth cations, or other cations.

Example 3

The procedure of Example 2 was repeated except that a calcium phosphate hydroxyapatite obtained from Rhône-

Poulenc Basic Chemicals in Shelton, Conn. was used as the ceramic powder to produce a sintered ceramic framework according to the invention.

Example 4

The procedure of Example 3 was repeated except that the calcium phosphate hydroxyapatite was prepared at the National Institute of Standards and Technology (NIST) in Gaithersburg, Md. according to the protocol for Standard Reference Material #2910 which was mixed with about 20 wt % poly(dimethylsiloxane) in a cyclohexane solvent and coated onto a titanium substrate. Upon firing at about 655° C. for about 10 minutes, the ceramic coating was bonded to the substrate.

Furthermore, it is to be understood that the crystalline form of the ceramic in the necks can be varied by post treatment of the partially sintered ceramic framework, i.e., an amorphous glass can be crystallized.

Having now disclosed our invention, it is readily apparent to those skilled in the art that modifications and variations may be made without departing from the spirit or scope of the appended claims.

We claim:

1. A process for low temperature formation of porous ceramic-based composite materials comprising the following steps:

(a) mixing a ceramic powder with an organometallic pre-ceramic precursor;

(b) heating, at a temperature from about 500° C. to about 1000° C., the mixture of step (a) to form a porous body of ceramic powder bonded by necks of ceramic material formed by heat decomposition of the pre-ceramic precursor.

2. The process of claim 1 wherein the organometallic pre-ceramic precursor is selected from the group consisting of polyorganozirconates, polyorganoaluminates, polysiloxanes, polysilanes, polysilazanes, polyphosphazenes, polyorganotitanates and mixtures thereof.

3. The process of claim 1 wherein the porous body is infiltrated with a material selected from the group consisting of monomers, oligomers, polymers, and mixtures thereof, which material is cured in situ.

4. The process of claim 1 wherein the pre-ceramic precursor is a poly(dimethylsiloxane).

5. The process of claim 1 wherein the heating is in air.

6. The process of claim 3 further comprising silanizing the porous body before the infiltrating step.

7. The process of claim 1 further comprising contacting the porous body with 3-methacryloxy-propyltrimethoxy silane before the infiltrating step.

8. The process of claim 4 wherein the heating is conducted at about 655° C. for about 10 minutes in air.

9. The process of claim 3 wherein the monomer is methyl methacrylate which is initiated by a process selected from the group consisting of thermally, chemically, photo- and combinations thereof.

10. The process of claim 3 wherein the curing is carried out at ambient temperature.

11. The process of claim 10 further comprising annealing the cured polymer at an elevated temperature.

12. The process of claim 10 further comprising post-curing the cured polymer at about 65° C.

13. The product produced by the process of claim 1.

14. The process of claim 1 wherein the mixture of step (a) is coated on a substrate prior to step (b).