is, therefore, apparent that the degree of micro cracking can be calculated, depending upon the particular compositions employed and the firing, coating and annealing schedules followed.

FIG. 5 sets forth the coated ceramic substrate in various stages of formation.

In FIG. 5*a*, wherein the temperature is greater than 500° C., the ceramic substrate 1 is overcoated with the first layer of biologically active glass 2.

In FIG. 5*b*, wherein the system has been cooled to room temperature, micro-cracks 3 appear in the coating 2 forming islands 4 of biologically active glass bonded, by ion diffusion, to the ceramic substrate 1.

FIG. 5*c* depicts a micro-cracked biologically active glass coated Al_2O_3 ceramic substrate overcoated with a second biologically active glass layer 5.

The thus coated Al_2O_3 ceramic substrates are ideally adapted for the formation of cement-free bone prothesis implants of unusually high strength and capable of forming bonds with biologically active tissue.

What is claimed is:

1. A method of coating a compacted Al_2O_3 ceramic surface with a biologically active glass, said ceramic and glass having different thermal coefficients of expansion, comprising:

(1) contacting said glass with said ceramic surface at a temperature and for a time sufficient to bond said glass to said ceramic surface by ion diffusion,

(2) cooling said coated substrate to a temperature sufficient to produce interconnected micro-cracks in said glass coating as a result of the thermo-mechanical stresses induced by the differential in thermal coefficients of expansion of said ceramic and glass, and

(3) overcoating said micro-cracked glass coating with at least one additional coating of biologically active glass.

2. The method of claim **1** wherein said biologically active glass contains, by weight:

SiO_2 — 40–62%
Na_2O — 10–32%
CaO — 10–32%
P_2O_5 — 3–9%
CaF_2 — 0–18%
B_2O_3 — 0–7.5%

3. The method of claim **1** wherein said biologically active glass contains, by weight:

SiO_2 — 45.0%
Na_2O — 24.5%
CaO — 24.5%
P_2O_5 — 6.0%

4. The method of claim **1** wherein said biologically active glass contains, by weight:

SiO_2 — 42.94%
Na_2O — 23.37%
CaO — 11.69%
P_2O_5 — 5.72%
CaF_2 — 16.26%

5. The method of claim **1** wherein said biologically active glass contains, by weight:

SiO_2 — 40.0%
Na_2O — 24.5%
CaO — 24.5%
P_2O_5 — 6.0%
B_2O_3 — 5.0%

6. The method of claim **1** wherein said ceramic surface has a thermal coefficient of expansion (0°–1,000° C.) in the range 50–75 $\times$ 10^{-7} in/in/° C. and said glass has a thermal coefficient of expansion (0°–1,000° C.) in the range 95–145 $\times$ 10^{-7} in/in/° C.

7. The method of claim **1** wherein each of said coatings is annealed.

8. The method of claim **1** wherein said glass is bonded to said ceramic surface at a temperature above 500° C.

9. The method of claim **1** wherein said glass coated ceramic surface is cooled so as to produce micro-cracks in said glass coating having a width less than 1 μm.

10. The product of the process of claim **1**.

11. A cement-free bone prothesis implant comprising the product of the process of claim **1**.

12. The method of claim **1** wherein said glass is contacted with said ceramic surface by coating said ceramic surface with a slurry comprising a solvent, an orgnic binder, and a biologically active glass frit having a particle size less than 74 μm.

13. The method of claim **12** including the steps of drying the slurry coated ceramic substrate and firing the coated substrate to burn off said organic binder.

14. A product of manufacture comprising a compacted Al_2O_3 ceramic surface coated with at least two layers of biologically active glass having a thermal coefficient of expansion different from that of said Al_2O_3 ceramic, said first layer being bonded to said ceramic surface through ion-diffusion and characterized by having interconnected thermo-mechanical stress induced micro-cracks therein, and said subsequent layer or layers being successively bonded thereover.

15. The product of claim **14** wherein said biologically active glass contains, by weight:

SiO_2 — 40 - 62%
Na_2O — **10 - 32%**
CaO — 10 - 32%
P_2O_5 — 3 - 9%
CaF_2 — 0 - 18%
B_2O_3 — 0 - 7.5%

16. The product of claim **14** wherein said biologically active glass contains, by weight:

SiO_2 — 45.0%
Na_2O — 24.5%
CaO — 24.5%
P_2O_5 — 6.0%

17. The product of claim **14** wherein said bilogically active contains, by weight:

SiO_2 — 42.94%
Na_2O — 23.37%
CaO — 11.69%
P_2O_5 — 5.72%
CaF_2 — 16.26%

18. The product of claim **14** wherein said bilogically active glass contains, by weight:

SiO_2 — 40.0%
Na_2O — 24.5%
CaO — 24.5%
P_2O_5 — 6.0%
B_2O_3 — 5.0%

19. The product of claim **14** wherein said ceramic surface has a thermal coefficient of expansion (0°–1,000° C.) in the range 50–75 $\times$ 10^{-7} in/in/° C. and said glass has a thermal coefficient of expansion (0°–1,000° C.) in the range 95–145 $\times$ 10^{-7} in/in/° C.

20. A cement-free bone prothesis implant comprising the product of claim **14**.

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