

herend (the polymerizing resin which is to be held to the solid substrate surface).

ADHESION PROPERTIES OBTAINED WITH A SURFACE-ACTIVE COMONOMER

Adhesion tests were conducted to evaluate the efficacy of the surface-active comonomer described in this example. A typical tensile adhesion test was used, similar to those commonly used by persons skilled in the art. In the first study, tensile adhesion, between the direct filling resin described above and six dentin surfaces after soaking for 20 hours in water, was only 0 to 20 p.s.i. (pounds per square inch) when the dentin was treated with: nothing; cavity primer; cavity seal; ethanol; and 5 percent ethanol solutions of oleic acid, Chinawood fatty acid, and N-phenyl glycine. A quick setting and a general purpose epoxy gave similar results. When a 5 percent solution of NPG-GMA (adduct of N-phenyl glycine and glycidyl methacrylate) was applied before the methacrylate resin, the value was between 150 and 320 p.s.i. Re-application of this NPG-GMA solution and resin without resurfacing gave increasing values to 660 p.s.i., which dropped significantly when the dentin was resurfaced before application. This is tentatively interpreted as follows: the NPG-GMA, a surface-active comonomer, significantly improved the bonding between the resin and the dentin surface; the surface condition, produced by the abrasive, was a limiting factor.

In a second evaluation, tensile adhesion, between a direct filling resin and five dentin surfaces after soaking for 20 hours in water, was only 0 to 10 p.s.i. when the dentin was treated with: nothing; 2-hydroxypropyl methacrylate; and 5 percent ethanol solutions of stearic acid, 12-hydroxy stearic acid, stearoyl sarcosine, and oleoyl sarcosine. When a 5 percent solution of NPG-GMA (adduct of N-phenyl glycine and glycidyl methacrylate) was applied before the methacrylate resin, the value was between 390 and 780 p.s.i. Exposure to water for 19 days did not significantly decrease the average bond strength. Pretreatment of the surface with dilute acid or base, followed by rinsing, blotting and then application of the NPG-GMA gave significantly higher adhesion values. Such treatment with 0.01 N NaOH gave 1000 p.s.i. after 4 days in water.

In a third study, more data were obtained and are shown in Table I.

Table I

	Adhesion of a Dental Resin to—		
	Dentin	Enamel	Fluorapatite
Control (resin only).....	0	240	910
NPA-GMA Applied before the resin.....	510	690	1,900
EDTA ¹ pretreatment and NPG-GMA applied before the resin.....	1,100	770	1,100

These average values are in pounds per square inch after soaking in water 1-3 days.

NPG-GMA is the surface-active comonomer.

¹ EDTA is ethylene diamine tetraacetic acid.

In this table it is evident that the surface-active comonomer is effective in improving the bond strength to fluorapatite single-crystal (100) surfaces in the absence of (dental) protein. The statistical evaluation of the ability of a surface-active comonomer to improve the bonding of a polymer to the surface of a solid containing metal atoms (calcium ions) showed it to be highly significant.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that this

invention is not thereby limited to the specific embodiments thereof.

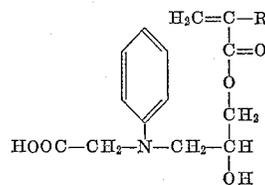
Encompassed by the spirit and scope of the present invention are also other examples of surface-active comonomers such as the following: the addition reaction product of glycidyl methacrylate or glycidyl acrylate and sodium salts of amino acids such as glycine, alanine, serine, threonine, valine, norleucine, leucine, isoleucine, phenylalanine, hydroxyproline, proline, cysteine, cystine, methionine, histidine, and tryptophan; sodium salts of amino acids such as lysine, ornithine, and arginine; and sodium salts of amino acids such as aspartic, glutamic and hydroxyglutamic. Other examples are the addition reaction product of glycidyl methacrylate or glycidyl acrylate with sodium salts of N-mono methylglycine (sarcosine); N-H, N-R-glycine, where R=1 to 20 carbon atoms; imidodiacetic acid, the monoester of imidodiacetic acid with a monohydric alcohol; ethylenediamine acetic acid, ethylenediamine diacetic acid, ethylenediamine triacetic acid; diethylenetriamine acetic acid, diethylenetriamine diacetic acid, diethylenetriamine triacetic acid, diethylenetriamine tetracetic acid; and N-H, N-R' glycine, where R' is an alkylaryl group.

What is claimed is:

1. The method of preparation of a surface active comonomer which comprises admixing in the presence of an aqueous solvent, equimolar quantities of the sodium salt of N-phenyl glycine and a compound selected from the group consisting of glycidyl methacrylate and glycidyl acrylate, subjecting said admixture, with stirring to a temperature between 23° C. to 30° C. for 2.5 hours, and separating the precipitate from the mother liquor by acidification to a pH of approximately 4.

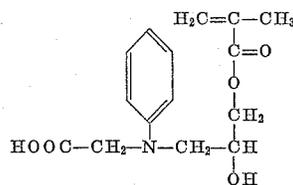
2. The method of preparation of a surface-active comonomer which comprises admixing in the presence of an aqueous solvent, equimolar quantities of the sodium salt of N-phenyl glycine and glycidyl methacrylate, subjecting said admixture with stirring, to a temperature between 23° C. to 30° C. for 2.5 hours, and separating the precipitate from the mother liquor by acidification to a pH of approximately 4.

3. The products of the following formula:



where R is selected from the class consisting of CH₃ and H.

4.



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