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3,200,142

**SURFACE-ACTIVE COMONOMER AND METHOD OF PREPARATION**

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This invention relates to a means of obtaining significantly improved adhesion between certain polymers and substrates. These improved polymers can be stably bound to external dental surfaces, to the walls of dental cavities, and to solid surfaces containing metals or metallic ions.

At the present time, none of the dental restorative materials have a significant degree of specific chemical or physical adhesion to the hard tooth tissues, and the retention of materials requires mechanical locking. This severely limits the application of the materials and requires the removal of extra healthy tooth structure for providing this mechanical retention. The direct filling resins which are used at present, because they have no bonding to the cavity walls, permit the development of secondary decay at the tooth-filling interface in a large proportion of cases.

It is, therefore, an immediate object of the present invention to provide a means of forming a water-resistant seal or bond between the polymer-containing direct filling material and the tooth cavity walls.

Another object of the invention is to provide improved means for bonding between polymeric materials and external tooth surfaces so that orthodontists may be able to give better service in the attachment of their appliances; so that periodontists may use better splinting techniques; so that prosthodontists will obtain better results in the cementing of their abutments; and so that general practitioners will be able to provide caries prevention by the filling of developmental pits and fissures.

Other, further, and more specific objects of this invention will become readily apparent to persons skilled in the art from a consideration of the following description, including specific examples. For instance, the present invention may provide improved bonding between certain polymers to be further described hereinafter, and solid surfaces containing metals or metal ions.

The direct filling resins most commonly used in dentistry at the present time consist primarily of methyl methacrylate monomer, with or without lesser amounts of other compatible monomeric materials, and a polymeric powder containing benzoyl peroxide or other suitable peroxide initiator. The powder and liquid are mixed together to produce a slurry; the slurry must contain a reducing agent which serves as an accelerator for the breakdown of benzoyl peroxide or other peroxide which in turn releases free radicals which attack the monomeric component thus initiating its polymerization. The polymerization precedes by a free radical mechanism until most of the monomer is converted to polymer. This polymerization, or hardening process, can and does occur in the dental cavity, and the present invention provides a means by which this kind of polymer can become stably bound to the cavity walls. Alternatively, other suitable polymerizing monomers and their polymers such as described

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in the U.S. Patent No. 3,066,112, may be bound to solid surfaces containing metals or metal ions, such as calcium. Other polymerizing monomers and their polymers such as polyester resins and other resins polymerizing by means of free radicals may utilize the present invention for obtaining improved bonding to surfaces containing metallic ions or metals.

The term surface-active comonomers is applied to the group of compounds of the present invention because it is a descriptive term appropriate to members of this group. The term surface-active limits the group to agents which have surface-activity in the usual sense of the word, that is, those materials which concentrate on surfaces at the expense of solution concentration. They typically consist of polar non-polar type molecules. The portion of low polarity is commonly hydrocarbon, unsaturated or saturated, and tends to be soluble in oil (organophilic) and insoluble in water (hydrophobic). The polar portion, or water soluble (hydrophilic) group, may be oxygen containing, may contain esters or ethers, may contain sulfur or may contain phosphorous or nitrogen. For the present purposes of description, surface-activity will be determined operationally by the method of Iler, R. K., U.S. Patent No. 2,657,149 (column 19, lines 28 to 54). In this test, Iler distinguishes powders which are hydrophilic from powders which are organophilic or hydrophobic. For the present purposes surface-active agents are those agents which, when added to a system containing distilled water, n-butanol, and powdered substrate which is innately hydrophilic, will change the apparent nature of the powdered substrate to become organophilic or hydrophobic.

The term surface-active comonomers also restricts these compounds to agents which are capable of copolymerization or homopolymerization. Tests for the ability to polymerize or copolymerize are well known to the art and need not be further defined or described here. Thus, a surface-active comonomer may be described as a molecule, one end of which consists of a polar group making the molecule surface-active for a given surface and the other end containing one or more relatively non-polar group or groups capable of copolymerization with the material to be bonded to the surface. The polymerizable end and the polar end of the molecule should be separated by some distance, preferably with a flexible hydrocarbon chain. This would serve to free the polymerizable group from steric hindrance and to separate the charge or charges of the ionic polar portion of the monomer and those of the growing chain radical so that the polymerizable group may approach the chain radical for reaction.

It must be kept clear that the polar group will be determined by the nature of the substrate surface, and the polymerizable group or groups will be determined by the nature of the polymerizing monomer and its polymer. It should be clear that the example to follow with its embodiment of the present invention does not limit the invention to this polymer to be bonded, surface-active comonomer mediating the bonding, and substrate of the bonding, and it should be understood of course that this disclosure relating in detail to only one of the embodiments of the invention does not obviate the changes and modifications of the surface-active agents making them suitable for other substrates and other polymerizing resins.