POLYMERIZABLE COMPOSITE MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 10/336,255, filed Jan. 3, 2003, entitled "POLYMERIZABLE COMPOSITE MATERIAL," now U.S. Pat. No. 6,797,767, issued Sep. 28, 2004, the disclosure of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

This invention relates to polymerizable composite materials and, more particularly, polymerizable composite materials that are useful in restorative dental applications.

BACKGROUND OF THE INVENTION

Within the field of dentistry, a variety of materials are used to replace or assist in replacing missing tooth structure, including restorative materials and bonding agents (often referred to as adhesives). A restorative material typically replaces a portion of the tooth structure, whereas a bonding agent acts as a bond between the tooth structure and the restorative material. Due to their different uses, restorative materials and bonding agents may have different properties and qualities. For example, bonding agents need to have sufficient fluidity and often require the presence of a solvent such as water, acetone or alcohol to be effective. Typically, bonding agents lack filler materials or have filler levels less than 5% by weight. As such, bonding agents lack sufficient strength or aesthetics to be used as restorative materials in situations which require larger restorative quantities. Restorative materials need to have physical properties such as high compressive strength and low wear, and preferably have an acceptable aesthetic appearance, e.g., tooth-like appearance.

One type of dental material includes resin-reinforced glass ionomers. Glass ionomers require water for all or part of their curing or setting mechanism and require the mixing of two or more ingredients immediately prior to use. However, their uptake of water during setting, their subsequent expansion or contraction and their generally poor overall performance in terms of esthetic appearance have limited the use of glass ionomers as restorative materials. See, e.g., U.S. Pat. No. 5,264,513 to Kunio.

Another type of bonding agent or adhesive includes dental materials containing acidic monomers. Acidic monomers are polymerizable compounds that contain acid groups such as phosphoric, phosphonic, phosphinic, sulfuric, sulfonic or sulfinic moieties. Acidic monomers, such as phosphate esters, are known. Buonocore discussed such materials as early as 1956 in J. Dent. Res., 1956, pp. 846-851. In addition, solvent based materials containing phosphate esters were described in *Adhesive Restorative Dental Materials,* 1961, pp. 195-198. Typically, these materials contain high levels of volatile solvents and contain little or no inorganic filler material. See, e.g., U.S. Pat. No. 5,089,051 to Eppinger et al. and U.S. Pat. No. 6,245,872 to Frey et al. Generally, acidic monomers have not been previously used in combinations greater than 40% by weight due to the difficulty in polymerizing acidic monomers in high concentrations and/or the diminished physical properties obtained. See, e.g., U.S. Pat. No. 5,733,949 to Imazato et al.

A category of dental restorative materials includes resin-based composite materials. These composite materials typically contain both reactive monomers and non-reactive fillers. They are also typically hydrophobic in nature and do not bond well to tooth structure. A tooth itself may contain between 5-20% water and is present in an aqueous oral environment. Ion releasing resin-based restorative materials, including non-acidic monomers, are described in U.S. Pat. No. 6,180,688 to Rheinberger et al.

SUMMARY OF THE INVENTION

In general, in one aspect, the invention features a polymerizable composite material including at least one multifunctional acid containing monomer having a concentration ranging from about 10% to about 85%, a non-reactive filler having a concentration ranging from about 1% to about 80%, a polymerization system having a concentration ranging from about 1.5% to about 15%, and water having a concentration ranging from about 0.1% to about 25%.

In general, in another aspect, the invention features a method for making a polymerizable composite material. At least one multifunctional acidic monomer having a concentration ranging from about 10% to about 85% is provided. A non-reactive filler having a concentration ranging from about 1% to about 80% is added. A polymerization system having a concentration ranging from about 1.5% to about 15% is added. Water having a concentration ranging from about 0.1% to about 25% is further added.

An advantage of the present invention is that it provides restorative dental materials that are compatible with and are aesthetically acceptable in an oral environment. Additionally, one embodiment of the invention provides a polymerizable composite material that seals and protects a tooth while providing adequate strength to be used in restorative dental applications.

The details of one or more embodiments of the invention are set forth in the accompanying figure and the description below. Other features, objects, and advantages of the invention will be apparent from the description and figure, and from the claims.

FIGURE

FIG. **1** is a Table summarizing the components of the composite materials described in the examples provided herein.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to polymerizable composite materials and methods of making such materials in which a strong, aesthetically acceptable dental restorative material is produced. The polymerizable composite material includes at least one multifunctional acidic monomer, a filler that does not react with the acidic monomer, a polymerization system, and may include water. The composite material may additionally contain other adjuncts to impart convenient handling characteristics and satisfy setting or curing requirements and other suitable qualities useful in restorative dentistry. For instance, the composite material may contain co-monomers to increase strength and reactivity of the material, water soluble salts such as sodium fluoride, and compounds to allow polymerization of the resin either by light curing or by auto polymerization.

The polymerization system typically includes initiators and accelerators which enable polymerization of the acid monomers when used in higher concentrations as well as in the presence of co-monomers.