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## Self-Healing Dental Composites

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### Background

Resin composites are popular materials to fill tooth cavities due to their esthetics and direct-filling capabilities. However, the materials are susceptible to micro-cracking brought on by thermal and mechanical stresses resulting from strong occlusal (chewing and clenching) forces. These micro-cracks can result in secondary caries formation and bulk fracture of the composite materials, limiting the service lifetime of dental restorations. Repair usually requires complete replacement of the resin filler material. There is therefore interest in developing self-healing materials that can extend the service life of dental restorations.

### Invention Description

Self-healing dental composites have been developed that incorporate two further functional components into the conventional dental composite materials. These additives are a healing powder (based on alumina and/or silica, such as strontium fluoroaluminosilicate particles) and a healing liquid encapsulated in silica nanoparticles. The healing liquid comprises water and polyacrylic acids. Surface treatment of the silica nanoparticles enhances bonding strength to the resin network, and also controls the fracture behavior of the nanoparticles. When a micro-crack occurs, the silica nanoparticles in the crack's path fracture, releasing the healing liquid, which reacts with the healing powder to produce a glass-ionomer cement that fills and seals the crack. The material physically integrates with other fillers inside the composite matrix to mitigate crack propagation.

### Potential Applications

The self-healing compositions can be used in dental applications such as

- Restorative materials
- Cements for single or multiple tooth prostheses

### Benefits and Advantages

- Materials used are clinically tested and biocompatible
- Improved service life for dental restoratives
- Maintains initial fracture toughness of the restoratives
- Elastic modulus is similar to commercial dental resin composites