Ask the Experts

NANOCOMPOSITES

Associate Editor
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QUESTION: What is a nanofill composite, and how does it differ from a microfill composite? What is the difference between a *nanofill* and a *nanohybrid*?

ANSWER: The term *nanocomposite* is becoming common in the field of dental restorative materials. But how accurate is it? Attempting to apply a rigorous definition to the term is difficult, but one useful guideline was presented in a recent article by Ure and Harris.[1] Quoting from this article, *nanotechnology* is "the deliberate placement, manipulation and measurement of sub-100 nanometer scale matter." Using this definition as a guideline, we can begin to classify and critique many of the composite materials on the market today.

The random distribution of the silica filler particles used in microfills means that most manufacturers use an "organic filler" approach whereby filler and resin are mixed, precured, crushed, and then used as filler in the resin matrix of the final composite. The silica microfillers typically have a diameter of 0.04 μm (40 nm). This approach to composite formulation yields good polishability, but other properties can suffer, for example, fracture toughness and marginal integrity.[2]

An alternate approach for obtaining good polishability is to add smaller particles to a hybrid composite. Most contemporary hybrids contain glass filler particles in the range of 0.6 to 1.0 μm, or 600 to 1,000 nm. The strength and wear resistance of such materials are appropriate for both anterior and posterior restorations. However, loss of the larger particles during clinical function results in a reduction of gloss over time.

Products are beginning to be introduced that better fit the definition provided by Ure and Harris. Filtek Supreme (3M ESPE, St. Paul, MN, USA), for example, uses nanometer-sized particles (20 or 75 nm) in a controlled manner. Some particles are added as discrete particles, whereas some are added as agglomerates, or clusters. These clusters are designed such that they break apart under occlusion, meaning that only a small particle is lost rather than the entire cluster. The clinical result is good retention of the original polish. The ability to control the surface area of the particles allows for the high filler loading needed to provide low wear and high strength.

So, what is a nanofill composite, and how does it differ from a microfill composite? The simple answer to this question is that nanotechnology allows a higher level of control than does the traditional microfill technology, with the result being materials that display the polish (and polish retention) of a microfill but the strength and wear resistance of a hybrid.

And what is the difference between a *nanofill* and a *nanohybrid*? Nanofills use nanometer-sized particles throughout the resin matrix, whereas nanohybrids take the approach of combining nanometer-sized particles with more conventional filler technology. Both approaches can provide good composite materials, but the nanohybrid approach still may suffer from the loss of larger particles and the potential loss of initial gloss.

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SUGGESTED READING

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Editor's Note: If you have a question on any aspect of esthetic dentistry, please direct it to the associate editor, Edward J. Swift Jr, DMD, MS. We will forward questions to appropriate experts and print the answers in this regular feature.

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