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COMPARISON REPORT

Research &Development Department

24/11/2010

NANOCERAM BRIGHT is a light cure nano-hybrid composite composed of a special blend of nano-fillers which produce a superior restorative. The highest aesthetic results have been achieved through the development of a sophisticated method for the integration of the nanoparticles in the resin matrix. These nanoparticles, of average particle size of 20 nm, assist in a quick polish after placement as well as ultralow wear.

The images below show the nanoparticles evenly dispersed within the resin matrix.

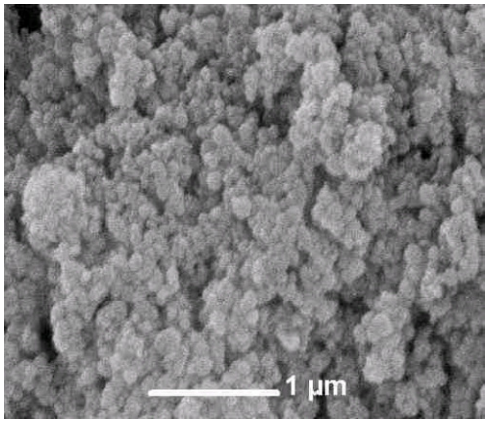

Figure 2: Silicon dioxide nanofiller with a mean particle diameter of approx. 20 nm

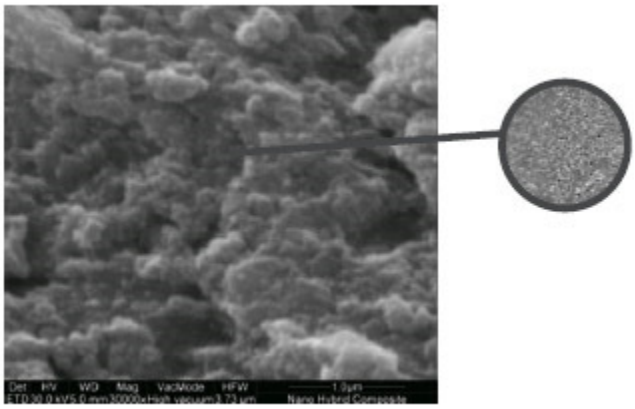

Figure 1: Nanoparticles evenly dispersed within the matrix

NANOCERAM BRIGHT is characterized by its ease in sculpting with no slumping. Its low polymerization shrinkage due to high loading and particle size blending; yields high marginal integrity, minimizing post operative sensitivity and eliminating micro leakage.

Characteristics - Advantages

- Excellent handling characteristics
- Excellent sculptability
- Low shrinkage-Very good marginal adaptation
- Extremely high polishability
- High resistance to wear
- Superior aesthetics
- Strongly radiopaque
- Non-sticky

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Physical Properties

Polish Retention

The clinical performance and the aesthetic appearance of a composite restoration are directly correlated to a good surface polish and the retention of it. In contrast a rough surface can lead to plaque accumulation and discoloration. Thus, DMP has paid particular attention to develop products with favourable polishing properties.

In order to determine the changes in surface gloss of different composite materials experimentally a simulation of mechanical aging mechanism (tooth brushing) has been applied.

Several samples of composite materials were prepared and the surfaces were polished wet using a Beuhler variable-speed grinder-polisher. The initial gloss was measured. In addition the samples were brushed with toothpaste and a toothbrush that was mounted on an Automatic Toothbrush Machine. Gloss measurements were taken after 500 cycles and 2000 cycles. The gloss measurements carried out using a Horiba glossmeter.

The study has shown (Figure 3) that **Nanoceram Bright** has initial gloss similar to or better compared to other restorative materials (eg. *Tetric Evoceram*, Herculite). The superiority of **Nanoceram Bright** is shown after 500 or 2000 toothbrush abrasion where the gloss results are significantly better or equal when compared to the other restorative materials (eg. Herculite).

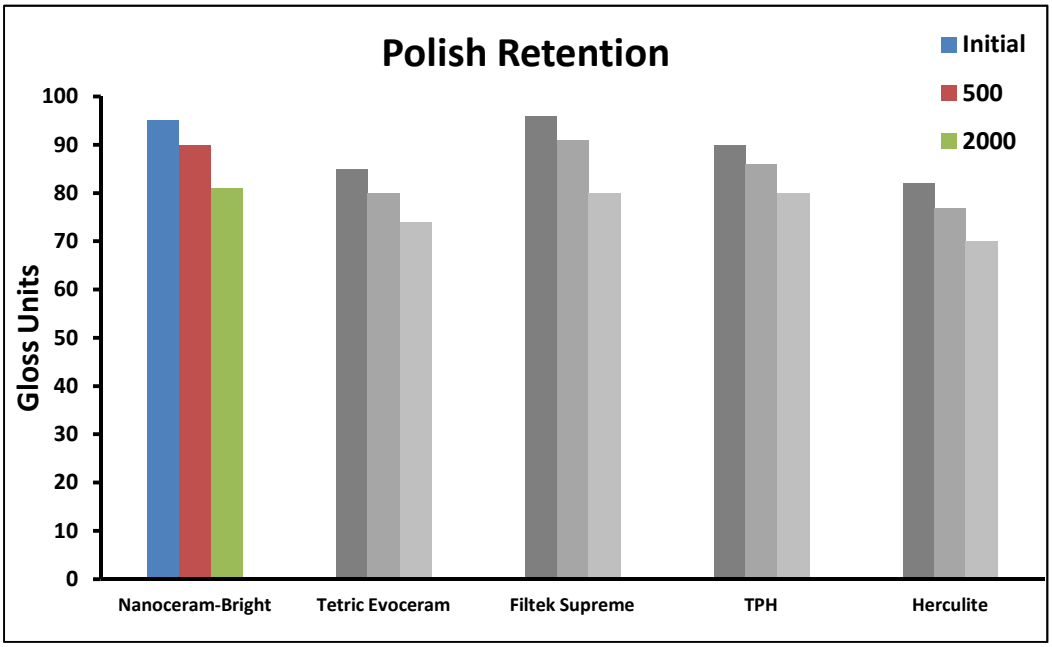

Figure 3: Polish retention of Nanoceram Bright versus other universal restorative materials

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Polymerization shrinkage

In order to restore a tooth in such a way that it is leakproof, there must be no dimensional mismatch at the tooth-restoration interface. Perfect adaptation should be obtained during polymerization and maintained for the lifetime of the restoration. Unfortunately, due to their chemistry all dental restorative products shrink during the polymerization reaction. Modern nano-hybrid composites have managed to reduce this effect significantly.

Studies have shown that low shrinkage results in less stress on the adhesive bond and lower deformation of the tooth structure during polymerization. The clinical importance of this is that it results in much better margin quality. Therefore polymerization shrinkage is an important property for the restorative materials.

There are several methods of measuring polymerization shrinkage in this study a method which called “linometer” has been followed. The results presented in Figure 4 below show that **Nanoceram Bright** is among the products with the lowest polymerization shrinkage and display far better behavior compared to *TPH* and *Herculite*.

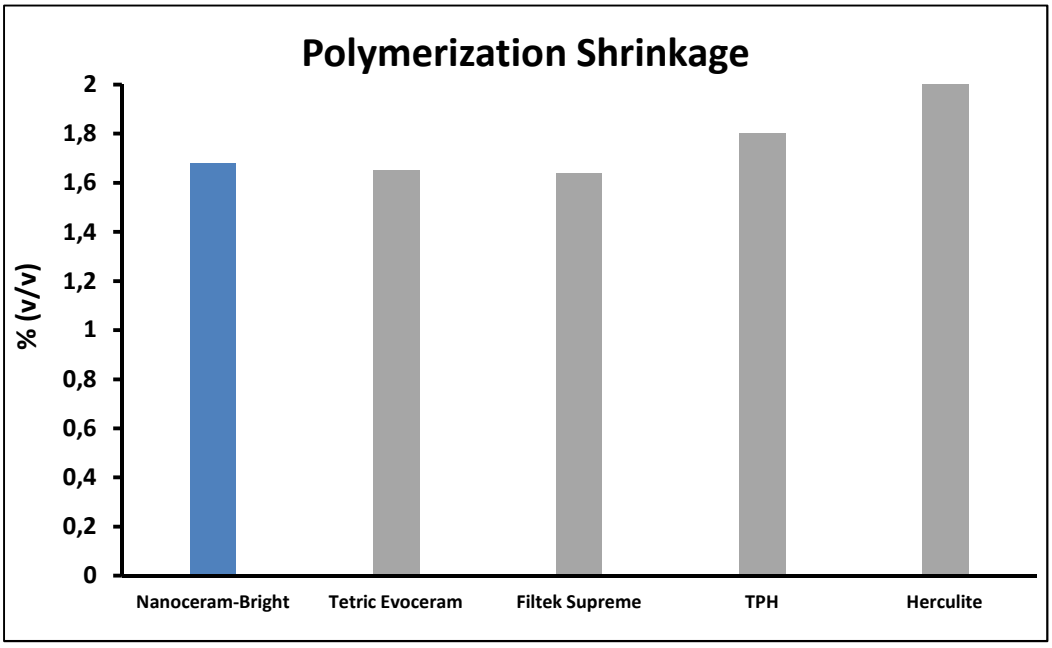

Figure 4: Polymerization shrinkage comparison

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Water sorption and water solubility

All resin-based dental materials demonstrate water sorption in the oral cavity while the restoration is in service. This is the amount of the water absorbed by the composite material on the surface and into the body. There are several negative effects that are associated with the water sorption and water solubility of the composites, such as the release of unreacted monomers. The release of unreacted monomers from resin composite may stimulate the growth of bacteria around the restoration and promote allergic reactions in some patients.
In addition the water uptake can lead to deterioration of the physical-mechanical properties of the composite such as dimensional stability, flexural strength, elastic modulus, compressive strength, wear resistance etc.

The unique formulation of **Nanoceram Bright** keeps the values of the water sorption and solubility to minimum compared to identical products of other companies as shown in Figure 5. The tests have been carried out at the University of Manchester.

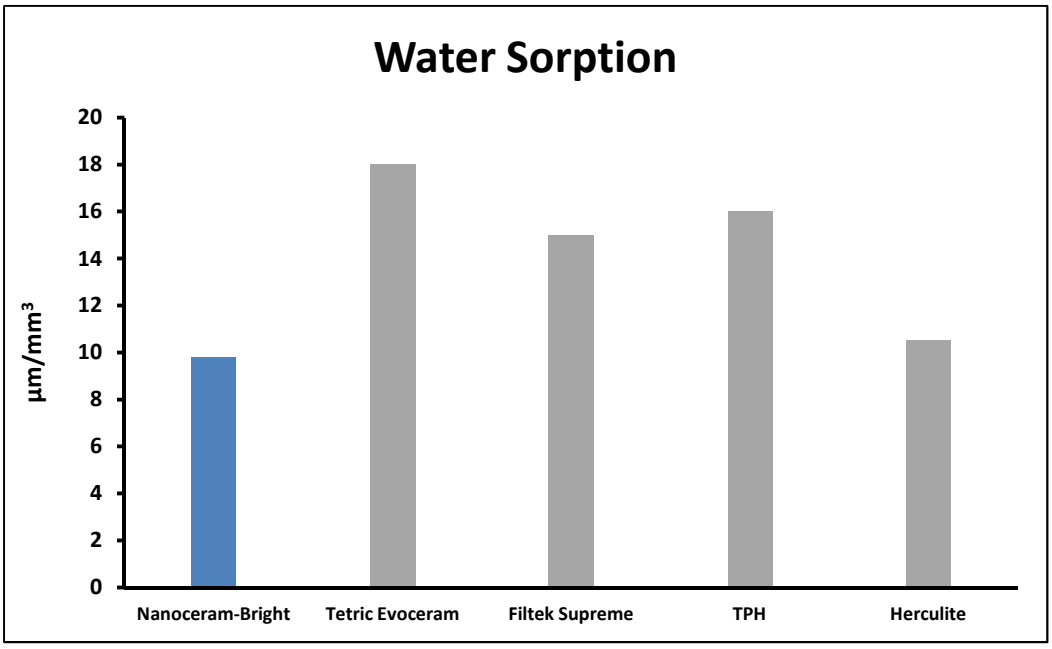

Figure 7: Water sorption comparison

*Tests have been carried out at the University of Manchester

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Mechanical Properties

Dental restorative materials are exposed to extremely heavy loads in the oral cavity especially on chewing forces. In order to construct a resistant and durable dental restorative material, the physical properties of these products must be optimized according to the relevant mechanical parameters. A set of test procedures has been established in order to rate the quality of the dental restorative materials.

Fracture Toughness and Flexural Strength

One test procedure is called fracture toughness and corresponds to the energy that is required to propagate a crack in a dental restorative material. The higher the value of fracture toughness the lower is the possibility of crack to propagate. This is similar (but not the same) to the 3-point bend technique (Figure 5), the values of which are called flexural strength. Therefore flexural strength, which is another physical property measured, is the ability of a material to resist deformation under load-chewing forces etc. (i.e. the value obtained when the material breaks).

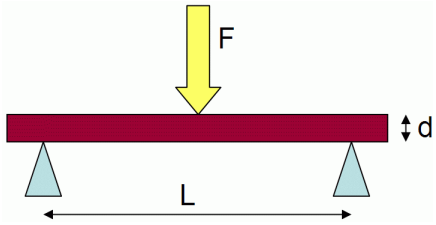

Figure 6: Material under 3 point bending

The results from these measurements presented in Figures 7 and 8 show that **Nanoceram Bright** has *higher values* of flexural strength or similar compared to other restorative material. Furthermore the flexural toughness of **Nanoceram Bright** is *superior* compared to other brands such as *Herculite* and *TPH*.

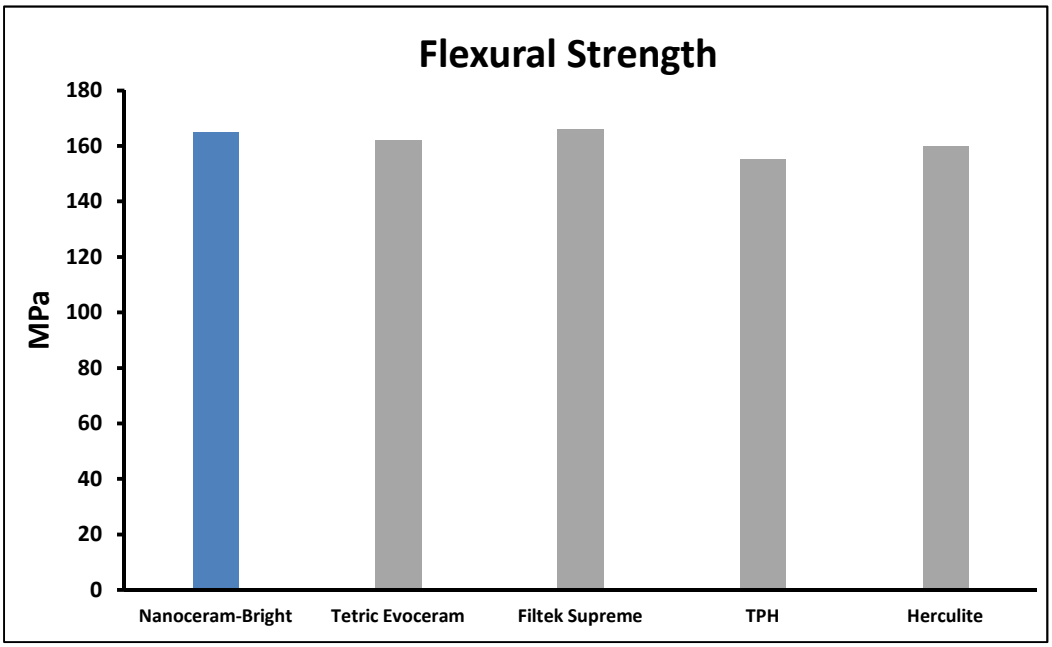

Figure 7: Flexural strength comparison

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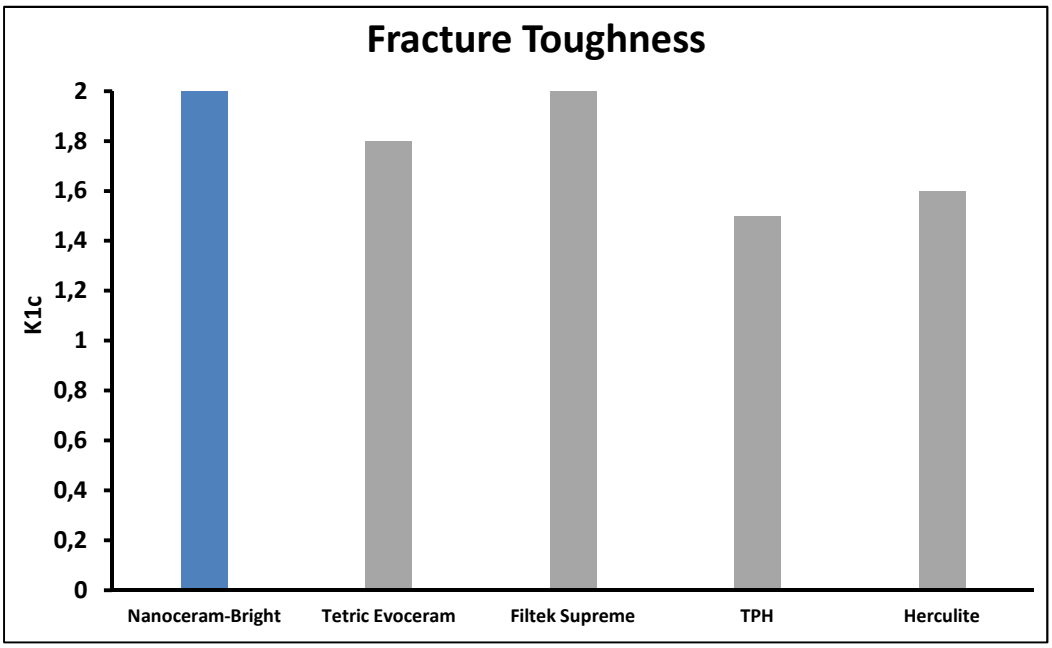

Figure 8: Fracture toughness comparison

Compressive Strength and Diametral Tensile Strength

Compressive strength is the ability of a material to withstand axially directed forces. It is of particular interest because it simulates chewing forces. For this particular study rods of the material are made and simultaneous forces are applied to the opposite ends of the sample length (Figure beside) in order to simulate chewing forces. The sample failure is a result of shear and tensile forces.

The diametral tensile strength is measured using a similar apparatus. However the compressive forces are applied to the sides of the sample (as the material is cylindrical), not the ends, until fracture occurs.

The results from these measurements presented in Figures 9 and 10 show that **Nanoceram Bright** has *higher values* of compressive strength and diametral tensile strength or similar compared to other restorative material.

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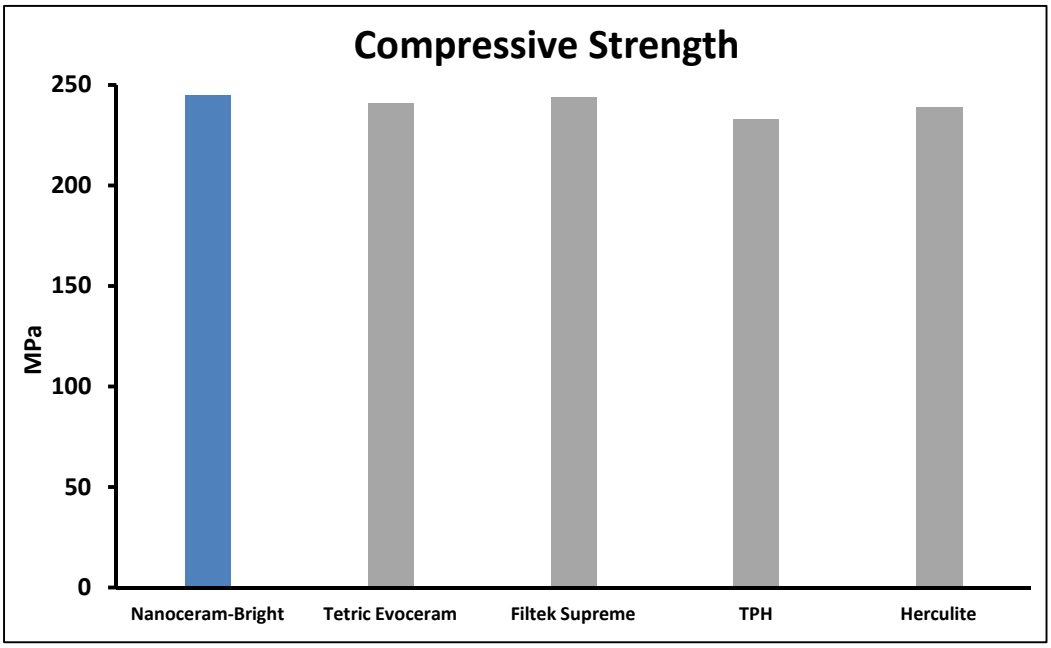

Figure 9: Compressive strength comparison

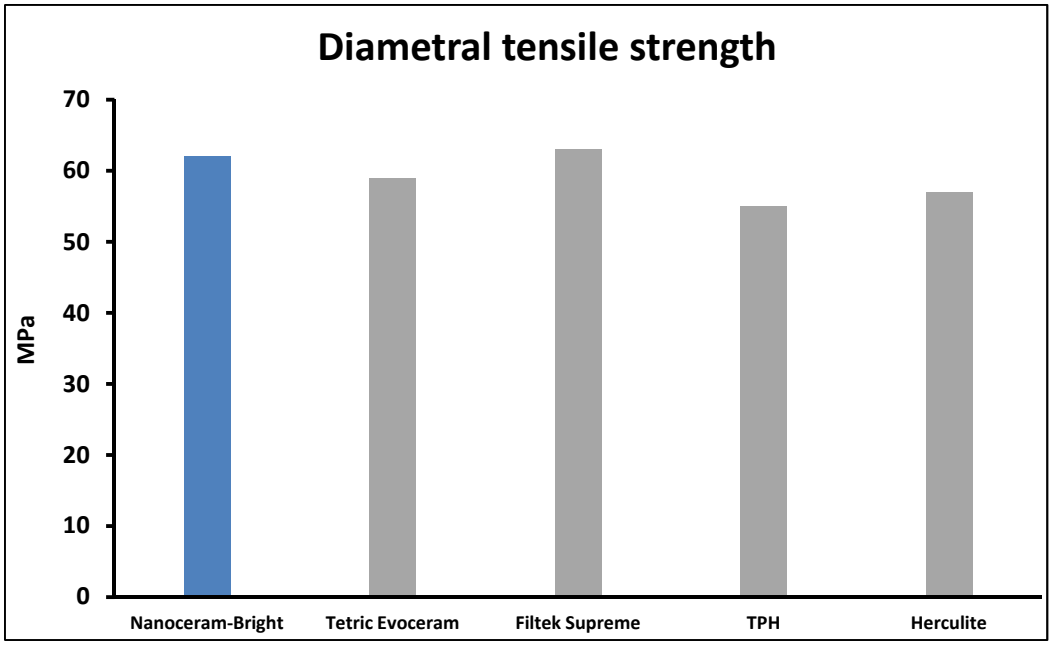

Figure 10: Diametral tensile strength comparison

All the above experiments have been conducted in accordance with ISO 4049:2009 specifications and the results meet the criteria of this specific standard.

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