Espertise™ Scientific Facts

3M™ ESPE™ Lava™ Plus High Translucency Zirconia shading – True colors explained

Lava™ Plus High Translucency Zirconia – the next generation of Lava™ Zirconia – is designed to enable unprecedented Lava™ restoration esthetics.

Esthetics is determined by the viewing light, the observer and finally the optical properties of the restoration: Restorations reflect, scatter or absorb part of the viewing light while the remainder is transmitted. Theses optical properties depend on the surface texture, the chemical composition and the microstructure of the materials used. Simplified one can say that the potential of a restoration material to mimic tooth structure is determined by its color and translucency.

Lava™ Plus is a complete system offering a high translucency zirconia combined with a tailored shading solution for full color control. This scientific facts sheet focuses on the science behind the Lava™ Plus System shading solutions.

How does zirconia shading work?

Dental zirconia shading was invented by 3M ESPE.

Lava™ Plus High Translucency Zirconia Dyeing Liquids from 3M ESPE are applied after milling to the porous green-state workpiece (Fig. 1). The color appears only after the sintering step when the zirconia is densified to the final polycrystalline state. The color is generated by ions incorporated into the zirconia.

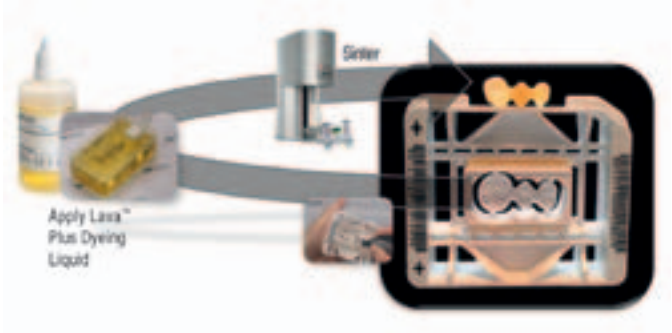

Fig. 1: Zirconia shading process.

The ions are dissolved in the dyeing liquid. By applying the liquid and subsequent drying the ions are deposited into the porous green-state zirconia work piece. During the sintering process the ions are built into the zirconia crystalline structure and where they produce the desired color.

Where does the color come from?

White light is composed of all wavelengths across the rainbow spectrum. Creating color works by absorption of certain wavelengths making the complementary color appear. Example: The green color of leafs is created by the absorption of both the red and blue portion of the spectrum.

The color impression in zirconia is generated employing the same principles as in some gemstones: e.g. adding 0.01 % of titanium and iron ions to colorless corundum results in a deep blue sapphire gemstone. Adding 1 % chromium to the same crystal leads to a deep red color and thus to a gemstone well known as ruby. So traces of ions can transform a colorless corundum crystal used on sandpaper into precious gemstones.

The ions built into the zirconia crystal lattice absorb part of the white light spectrum to achieve color. Lava™ Plus Dyeing Liquids transform the pure white Lava™ Plus Zirconia workpiece into a beautiful restoration with a warm, natural intrinsic tooth color (Fig. 2).

Fig. 2: Lava™ Plus monolithic All-Zirconia crown custom shaded with Lava™ Plus Dyeing Liquids.

3M ESPE

What is behind the warm and natural look of shaded Lava™ Plus Highly Translucent Zirconia restorations from 3M ESPE?

Comparing the transmission spectra of different shaded zirconias reveals a clear difference between the Lava™ Plus System and other zirconias (Fig. 3). The unique technology employed for 3M™ ESPE™ Lava™ Plus High Translucency Zirconia Dyeing Liquids shows two distinct absorption peaks with a transparency window in the green to yellow range.

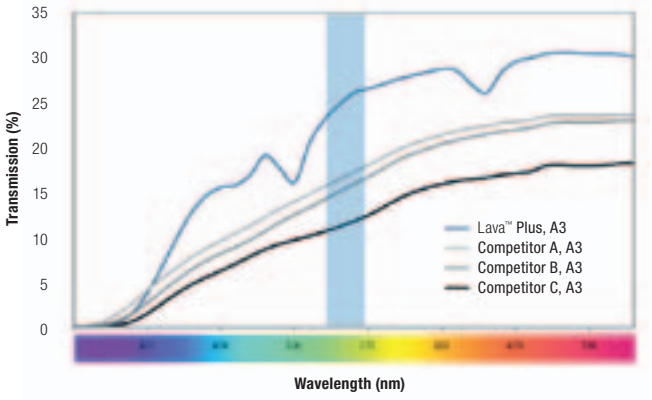

Fig. 3: Transmission spectra of shaded, polished zirconia discs with 1 mm thickness (Color i7, 3M ESPE internal data).

This transparency window is of special importance for the warm, natural appearance of Lava™ Plus Zirconia: The human eye sensitivity is not the same for every wavelength. The lowest sensitivity of the human eye is in the blue and red and the highest is in the green-yellow range.[1] The range of highest light sensitivity of the human eye and the transparency window of shaded Lava™ Plus Zirconia overlap leading to a higher perceived liveliness of shaded Lava™ Plus restorations.

This unique feature of the Lava™ Plus Dyeing Liquids also helps to better maintain the translucency after shading.[2]

How does the Lava™ Plus Zirconia shading technology ensure a precise color match?

The color greatly depends on the ions used and the precise control of their concentration and distribution after drying. Moreover the color achieved is determined by the microstructure of the zirconia. Zirconias have different grain sizes and grain size distributions coming from differences in the chemical composition, the pressing and the sintering process. True colors can only be achieved by customizing the shading liquids to one specific zirconia.

To precisely tune the colors Lava™ Plus Dyeing Liquids utilize a unique technology based on 3 different ions: One ion component for yellow color, one for red and for gray (Fig. 4). Lava™ Plus Dyeing Liquids are Cobalt and Chrome free.

[1] E.g.: Van Noort, Introduction to dental materials, 3rd Edition 2007, Mosby Elsevier, P. 57

[2] Contrast Ratios of Uncolored and Colored Zirconia Materials, Schechner G, Dittmann R, A. Fischer, Hauptmann H, J Dent Res 91 (Spec Iss A):1323, 2012

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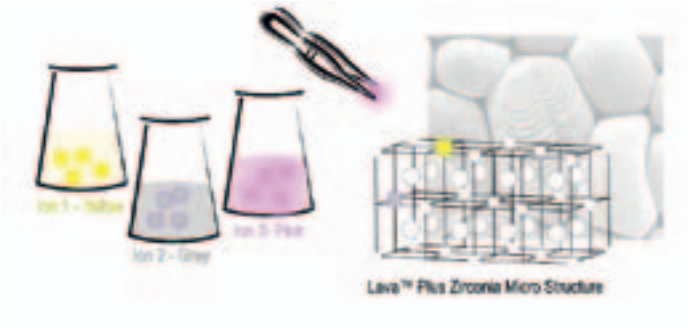

Fig. 4: 3-Ion shading principle of Lava™ Plus High Translucency Zirconia.

Each Lava™ Plus Dyeing Liquid is a fine-tuned mixture of these three ionic components. The result is a full offer of 18 dyeing liquids covering the 16 VITA classical A1-D4 shades plus two bleach shades. A special organic additive in the Lava™ Plus Dyeing Liquids ensures uniform distribution of the ions within the presintered material and makes sure the ions stay put during drying until the sintering where the organic compound is completely burned out.

Lava™ Plus Dyeing Liquids are designed specifically for Lava™ Plus Zirconia and can therefore offer true colors with excellent color match to VITA classical. (Fig. 5)

Fig 5: Color match comparison of A4 shaded 3-unit bridge frameworks cut through the connector. From left to right: Competitor 1, Competitor 2, Lava™ Plus Zirconia, VITA classical shade guide.

Some zirconias are not offered with a dedicated, tailored shading system. Trial and error is required to find ways to match colors with theses zirconias. With Lava™ Plus System the technician gets the right shade from the start to finish his masterpiece with ease.

Bottom Line

Dental zirconia shading was invented by 3M ESPE and works by incorporating ions into the zirconia crystalline structure during sintering.

Lava™ Plus Dyeing Liquids are tailored to the microstructure of 3M™ ESPE™ Lava™ Plus High Translucency Zirconia enabling an excellent color match to VITA classical shade guide. In addition the unique 3M ESPE technology leads to warm, natural colors and supports the translucency of the shaded material.

Lava™ Plus Dyeing Liquids can be used for uniform dip shading or in the custom shading technique that allows achieving any shade gradient within the zirconia. For even further intrinsic customization the Lava™ Plus System offers 8 effect shades for intense color effects and fluorescence.

With the intrinsic shading capabilities the Lava™ Plus High Translucency Zirconia System offers an ideal base for both veneeered and monolithic restorations – Technicians can achieve excellent results due to the warm, natural and matching colors of Lava™ Plus restorations and frameworks.