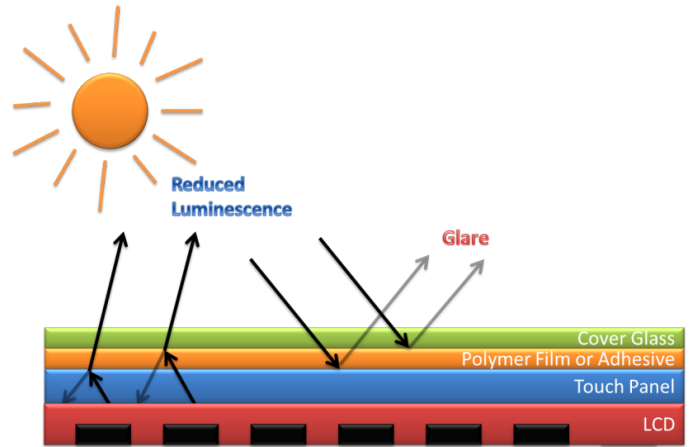


PixClear™

High Performance Nano-Zirconia Additives for Advanced Electronic Applications

PixClear™ nanocrystal dispersions are revolutionizing light management in display and lighting applications. Poorly matched materials in display devices can lead to glare, lower brightness, reduced luminescence and wasted energy and can even result in premature **device failure**. There has never been a greater need to match the refractive indices between polymer films and inorganic materials which can significantly **improve the light output** and readability of modern **touch screens** and **displays**. Additionally, when incorporated in solid state lighting applications, such as **LEDs and OLEDs**, index matching can significantly improve light output and device reliability. The addition of high refractive index PixClear™ nanocrystals to polymer systems achieves this goal cost effectively, without the need for special equipment or high temperature thermal cycles typically required with similar inorganic solutions.

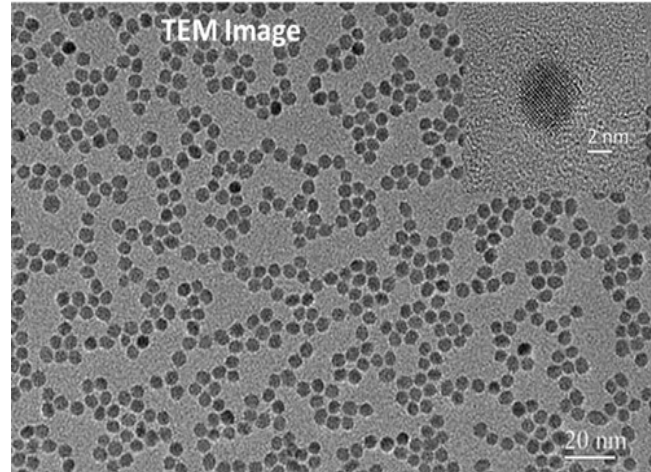
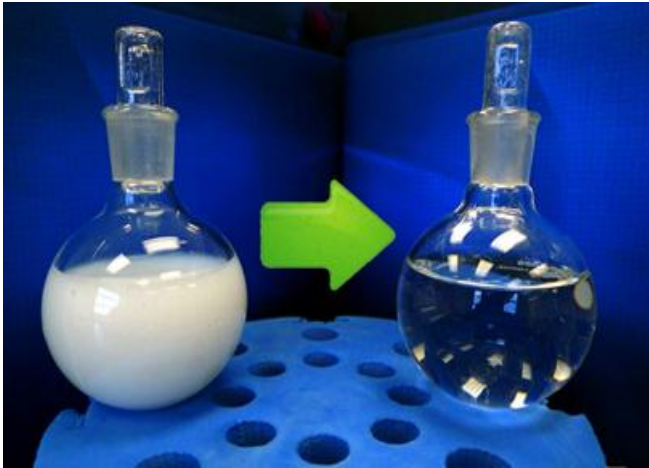


Typical Touch Screen

Applications	Properties	Advantages
<ul style="list-style-type: none"> ITO Hiding Layer for Touch Screen LED & OLED Light Extraction CMOS Image Sensor Lenses and Packaging Hard Coatings with Index Matching Wafer Level Opto Assemblies 	<ul style="list-style-type: none"> Tunable Nanocrystal Size from 3 nm to 7 nm with Narrow Size Distribution Highly Crystalline Well Passivated Surface Aggregate Free Suspensions Compatible with Various Solvents, and Polymers High Specific Surface Area High Bulk Hardness 	<ul style="list-style-type: none"> High Refractive Index Highly Transparent at the Visible Wavelengths Low Haze Coatings Even at High Nanocrystal Loading Improved Scratch Resistance and Hardness Improved Anti-Corrosion Improved Chemical Resistance

PixClear™

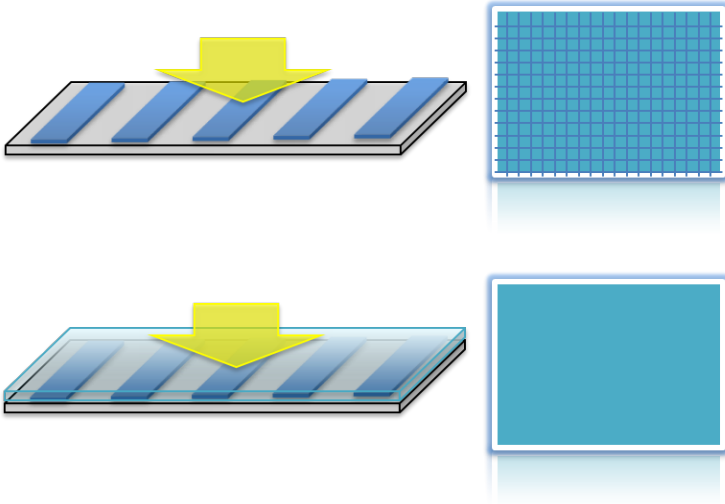
Challenge: Typical nanocrystals are poorly dispersed and highly agglomerated, which translates into poor performance when incorporated into a polymer matrix. Many have shelf lives measured in days versus months and have high viscosities that inhibit processibility and cannot be used in standard manufacturing process equipment.



Standard dispersed vs PixClear™ dispersed nanocrystals

TEM Image of PixClear™

Typical Nanocrystals	Pixelligent PixClear™ Nanocrystals
<ul style="list-style-type: none"> • Poor dispersion (cloudy) • Significant increase in viscosity • Poor transparency • Limited loading capability • Limited options on suspension media 	<ul style="list-style-type: none"> ✓ Well dispersed high transparency suspensions ✓ Little change in viscosity even at high loadings ✓ >3 month self-life with high transparency ✓ Capability to load nanocrystals > 80 wt% ✓ Compatibility with large selection of monomers and polymer



Solution: Pixelligent PixClear™ zirconia nanocrystals are **tailored to be dispersible** in a wide variety of monomers, and polymers. Pixelligent's **patent pending** synthesis and surface modification technologies produce **high quality** dispersions that are easily incorporated into many of the most widely used polymer systems. This results in **better** end-product **performance** and enables formulations with nanocrystal loading in excess of 80 wt% to reach a **refractive index** as high as **1.85**. This added benefit translates into greater flexibility to **index match** dissimilar materials, and compatibility with modern high-speed polymer **film forming techniques**.

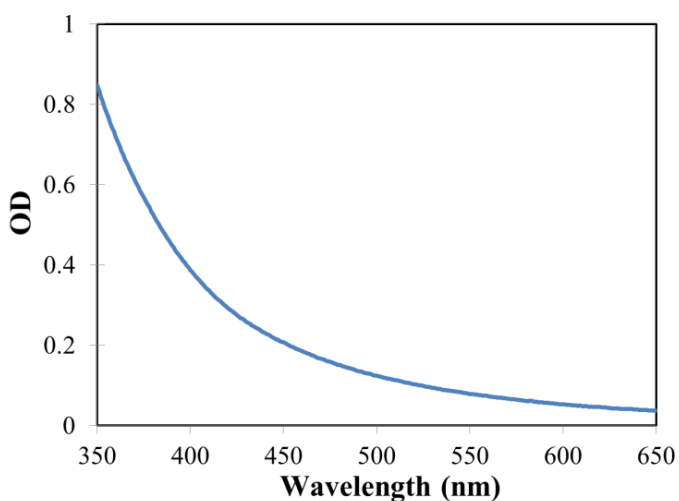
ITO hiding without (top) and with (bottom) index matching conformal coating

PixClear™

Typical Physical Properties

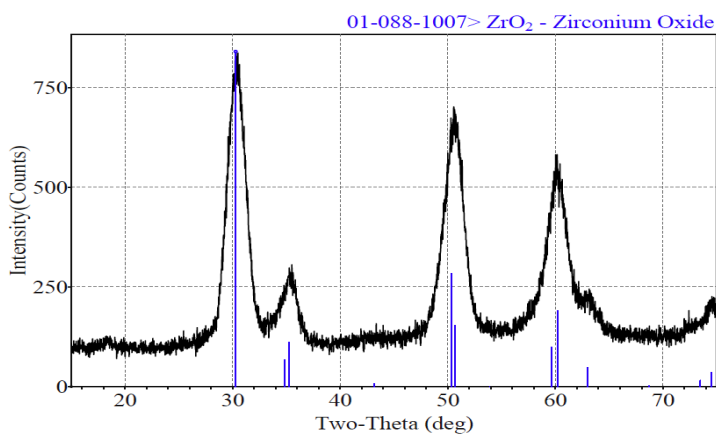
UV-Vis Spectrum

A typical UV-Vis spectrum of PixClear™ shows low absorbance and scattering in the suspension through a 1 cm path length even at 50 wt% loading in a solvent.



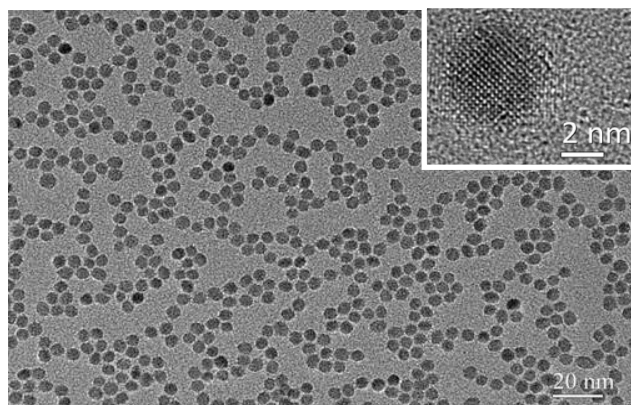
XRD Pattern

A typical XRD pattern shows highly crystalline particles.



Particle Size

A typical TEM image of PixClear™ shows spherical nanocrystals with 5 nm size and narrow size distribution.





THE CLEAR SOLUTION™

Particle Size Distribution

The dispersions are aggregate free with 99.99% (by volume) of the zirconia contained in nanocrystals with a diameter < 30 nm as measured by Dynamic Light Scattering (DLS).

