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The Clear Solution™

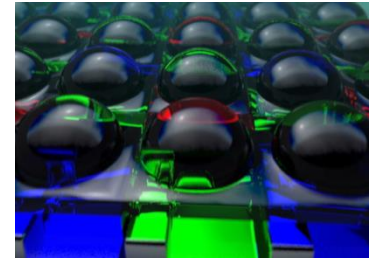
Nanomanufacturing Summit 2013

***Dan Russell, Senior Vice President of
Manufacturing and Operations***

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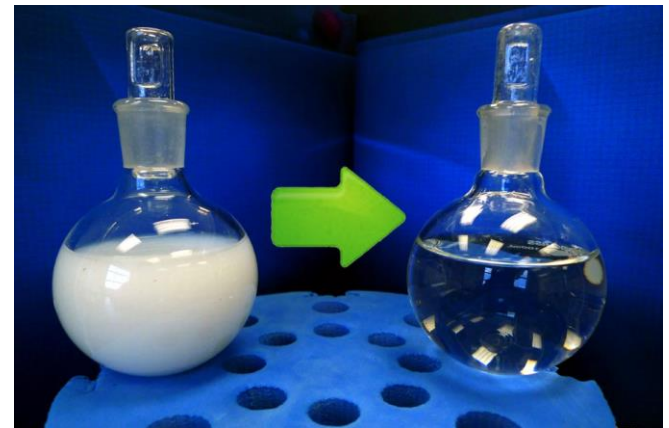
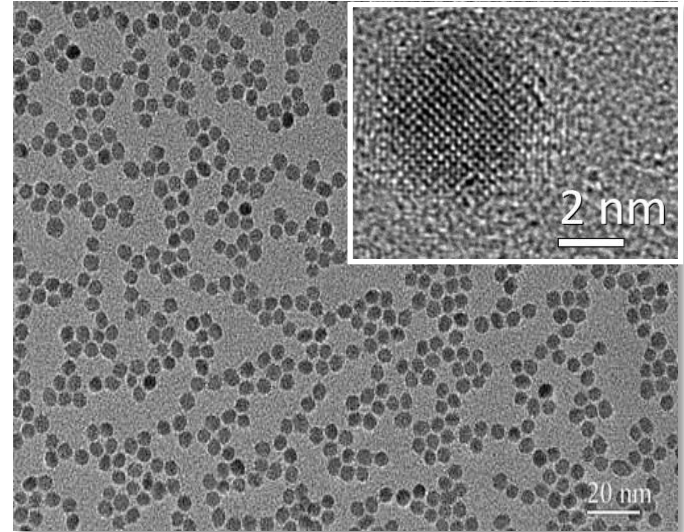
Corporate Overview

- PixClear™ ZrO₂ Nanocrystal Dispersions
- Electronics, Semiconductor and Industrial Markets
- Global Customer Base
- State-of-the-Art Pilot Manufacturing Facility
- \$20 M Invested To Date



Pixelligent's "Secret Sauce"


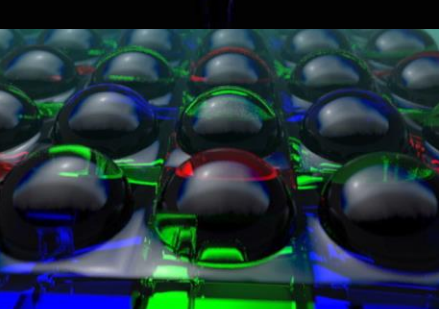

- ZrO_2 Nanocrystals & Dispersions
- Tunable size: 3 nm - 7 nm
- Best Dispersions Available
- High loadings (>80wt%)
- Highly scalable process
- 12 Patents Issued
 - 22 Patents Pending



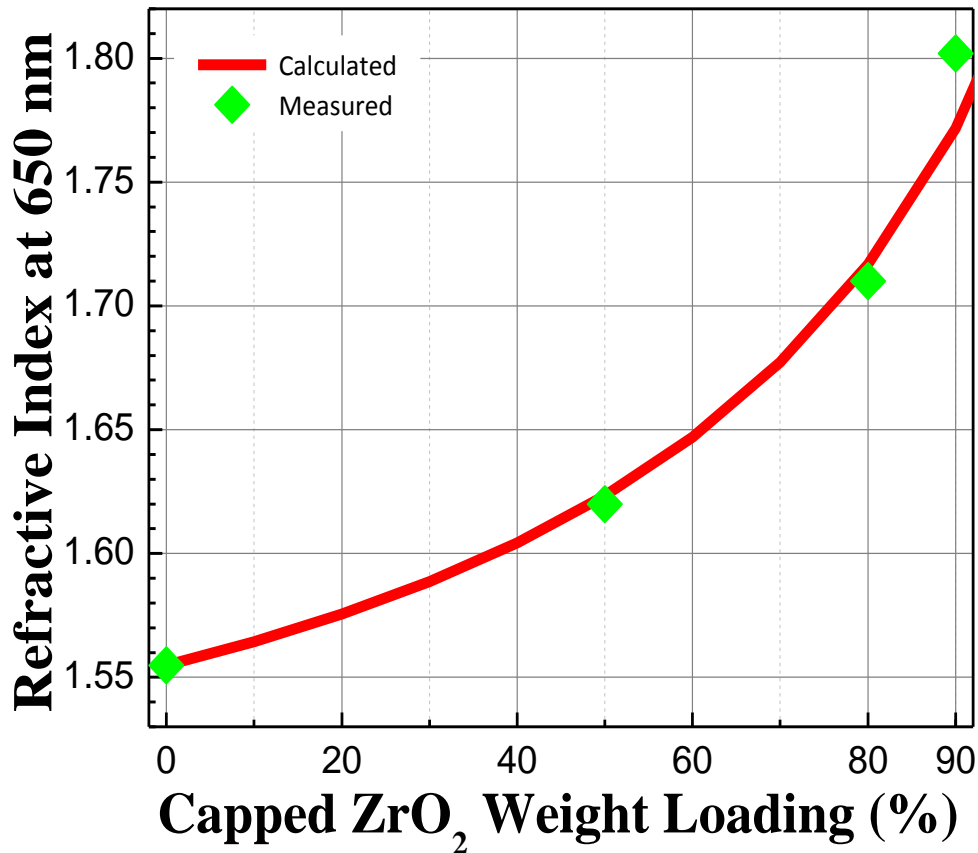
Key Features of ZrO₂ Nanodispersion Technology

- High Refractive Index dispersions in monomers, polymers, oils, and solvents.
- Relatively low viscosity even at high loadings (>80% wt.)
- Shelf life stable for > 12 months
- No special mixing equipment to formulate
- Dispersible directly in liquid monomers without solvent for UV curable coatings.



Market Segment	Applications	Features	Benefits
	HB LED's & OLED's	<ul style="list-style-type: none"> • Dramatically Increase RI: 1.5 → 1.8+ • Improves scratch resistance • Thermally stable 	<ul style="list-style-type: none"> • Significantly increases light output: 5%-15% • Reduces heat • Improves energy efficiency & lifetime
	CMOS Image Sensors	<ul style="list-style-type: none"> • Dramatically Increase RI 1.5 → 1.8+ • Simplifies lens design • Simplifies mfg. process 	<ul style="list-style-type: none"> • Less expensive sensors • Enhanced image quality • Smaller Package
	Touch Screen	<ul style="list-style-type: none"> • Dramatically Increases RI 1.5 → 1.8+ • Hiding ITO and other transparent conductors both on PET and Glass • TiO2 replacement • UV Light Stable 	<ul style="list-style-type: none"> • Conductor hiding • High Transparency • Improved Scratch Resistance • Strong Adhesion

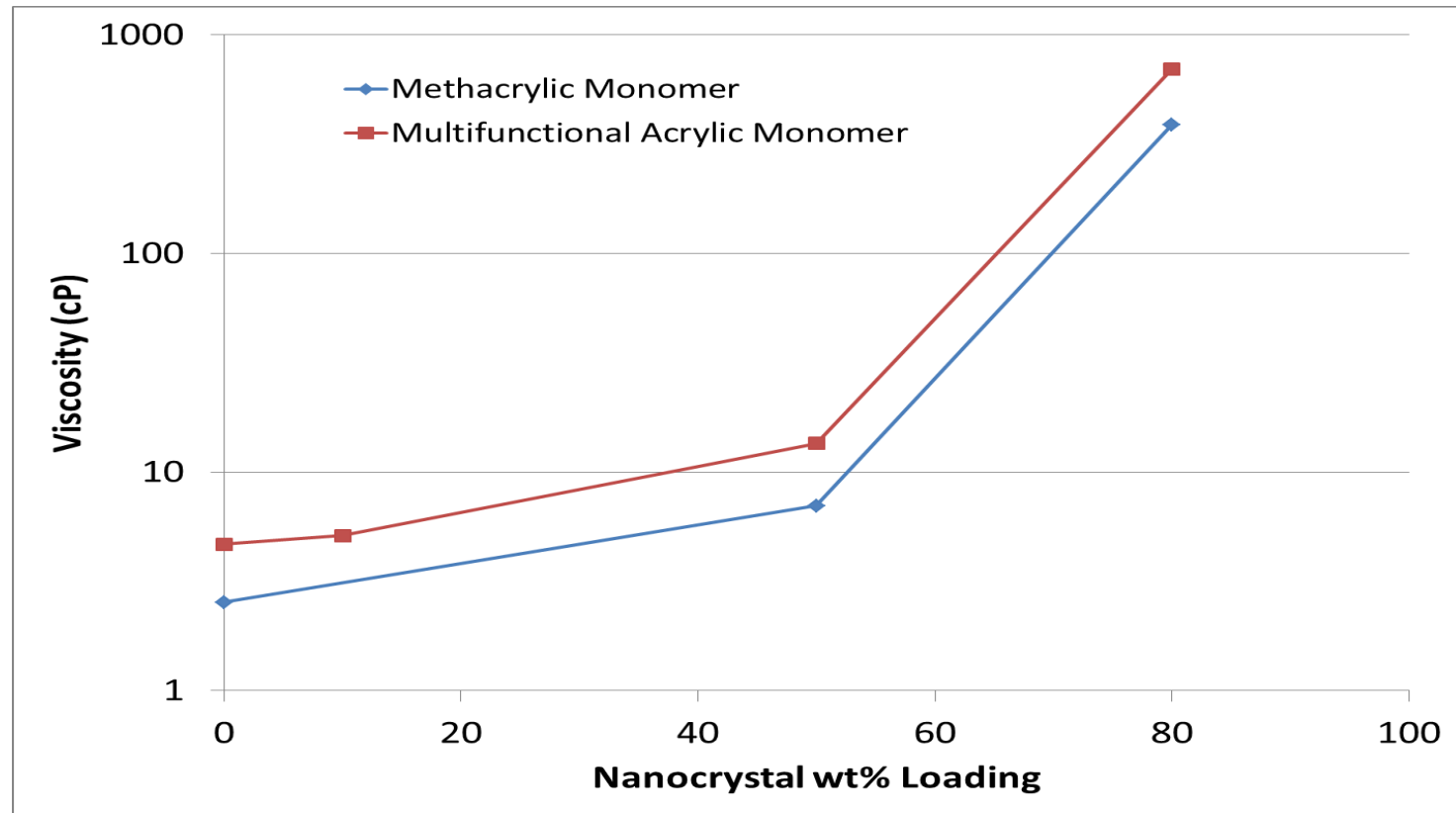
R.I. of ZrO₂ Nanocomposite 3um Film in Acrylic Polymer



Loading	k	Haze
90 wt%	<10 ⁻³	0.5%
80 wt%	<10 ⁻³	0.5%
50 wt%	<10 ⁻³	0.5%
0 wt%	<10 ⁻³	0.4%

Measured by J.A. Woollam with VUV-VASE

Viscosity vs. Nanocrystal Loading In Acrylic Monomers

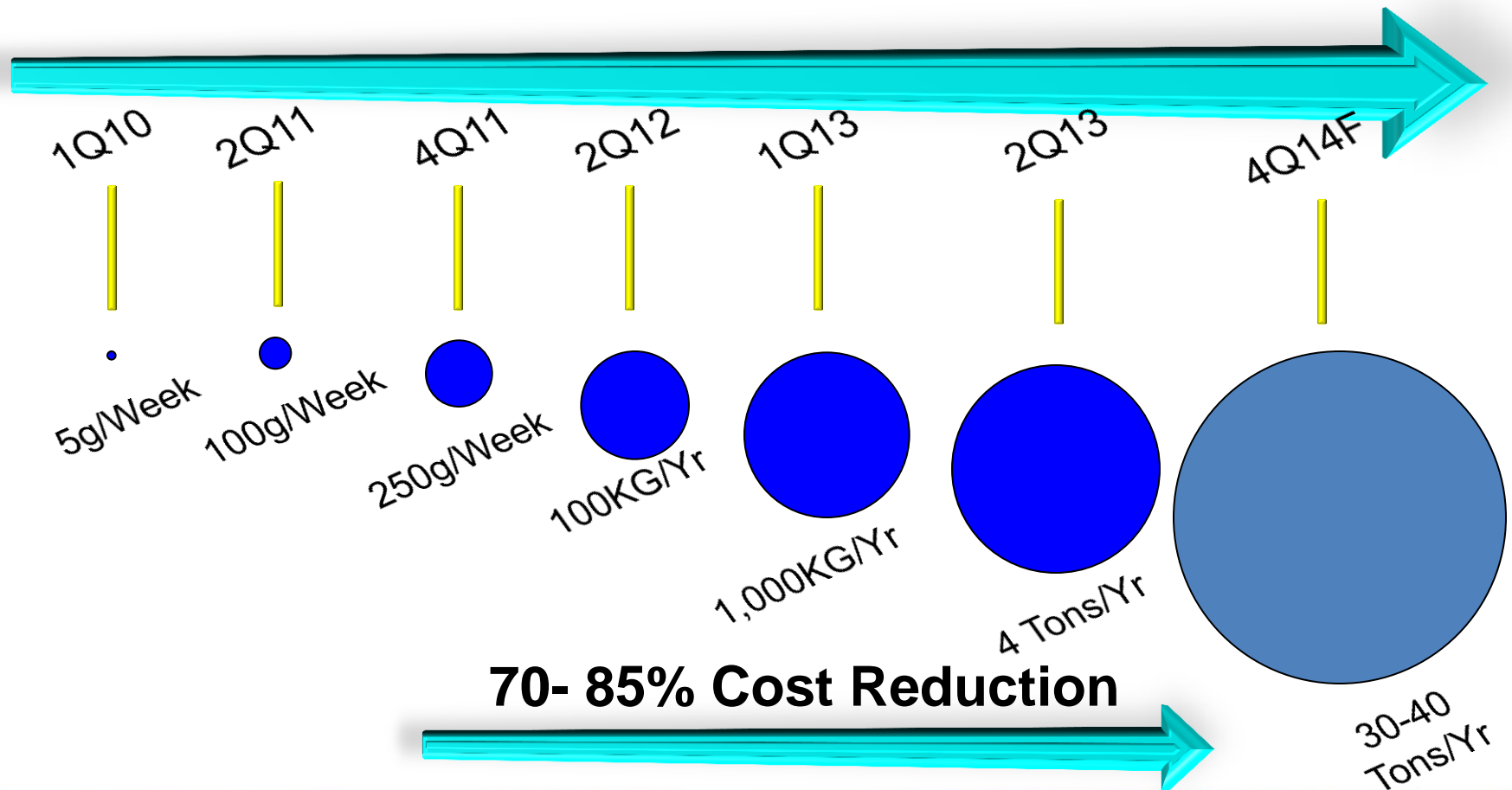


- Minimal viscosity change at 50% loading by weight
- Retains process ability at loading >80% by weight

Manufacturing Scale Up Roadmap

ZrO₂ Nanocrystal Dispersions

Capacity Scale-Up Timeline



30 Gallon Pilot Line

Nanocrystal Synthesis
30 Gallon Reactor



Capping Process



Wash Centrifuge,
Cleaning of Final
Dispersion



Scaled to 4 Tons/yr

Balancing Nanomanufacturing Risks & Investments

➤ **Nanomaterials Risk**

- Stability/Shelf Life
- Processability
- Material Handling
- Worker Safety/Customer

➤ **Scale-up Risk**

- Employee Safety/Hiring
- Capital Investments
- Meet Customer Requirements
- Cost Reductions

➤ **EPA Regulatory Risks**

- Bundling of Nanomaterials
- Evolving and unpublished policies and protocols
- Unclear guidance



- Uncertainty
- Time to market delays

➤ **Investment Risks**

- Raising Capital
- Equipment Selection
- Site Selection
- Market Timing
- Customer Acceptance
- Regulatory Approvals
- Managing Uncertainty

Health, Safety, and Environmental Scale up Risk Mitigation

Risk	Mitigation
Nano particle exposure	<ul style="list-style-type: none"> - Liquid based synthesis and closed material handling strategy - Proactive engagements with NIOSH for process assessments – Excellent results to date.
Environmental Release	<ul style="list-style-type: none"> - Liquid based synthesis minimizes air release potential - Non-aqueous process and waste handling protocols minimize water release potential
High Pressure Reaction	<ul style="list-style-type: none"> - Continuous process pressure monitoring with passive overpressure containment system.
Solvent Based Process	<ul style="list-style-type: none"> - Utilization of “intrinsically safe” facility, process, and equipment design strategies where possible. - Thorough Process Hazard Assessment (PHA) discipline - Mitigation of exposure risks with facility and process design and reliance on PPE as back up only.
TSCA Compliance	<ul style="list-style-type: none"> - Early engagement, good communication - Products are fully TSCA compliant

Keys to Technology Scalability

- **Equipment** – Standard materials and processes in custom configurations. Available from multiple suppliers.
- **Raw Materials** – Readily available. In most cases from multiple sources.
- **Labor** – Standard skill sets available from Chemical, plastics, or pharmaceutical industries
- **Technology** – Very repeatable and robust with process recipes transferred from engineering scale to pilot scale with in spec product produced from the 1st run!

Wrap Up

- **Highest quality ZrO₂ nano dispersions in the world**
- **Producing at “metric ton” scale today**
- **Proven Scalable – Scaling risk virtually eliminated**
- **Dramatic cost reductions supporting pricing in line with market expectations**
- **Successful launch of PixClear™ family of additives**
- **Progressing to “tens of metric tons” scale in 2014**



The Clear Solution TM

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