Technology Presentation 2013

Thomas F. Choate
Chief Technology Officer & Founder
Nanovere Technologies, LLC

http://www.nanocoatings.com
Nanovere focuses on the research, development, manufacturing and licensing of highly functional dendritic coating resins and multi-functional nanocoating formulations.

We specialize in solving complex coating issues, and focus on developing nanocoatings with a first-to-market approach;

- 1st Wipe-On Clear Coating to Exceed Automotive OEM Specifications
- 1st De-Icing Coating for Aerospace
- 1st Highest Scratch Resistance for Automotive
- 1st Brake-Dust Release / Filiform Corrosion Resistance for Wheels
- 1st Highest Chemical Resistance for Automotive Interiors
- 1st Multifunctional Self-Cleaning Clear for Industrial Markets
- 1st Coil Coating with 6H pencil and O-T flexibility

Nanovere has developed a complete platform of market-ready dendritic based coating resins and multi-functional nanocoating formulations. Vecdör & Nano-Clear nanocoatings have been proven to be the most scratch resistant in the automotive OEM industry. Nanovere is 1st to market “low-cost” highly functional dendrimers in coating systems globally. Vecdör PE dendrimers dramatically improve cross-link density in conventional polymer and coating systems.

Nanovere holds 2 global patents and 8 global patents pending. Nanovere has strategic partnerships with end-use customers, paint manufactures and polymer manufactures. Our business model supports the entire value chain through joint cooperation.
Nanocoating Difference

Conventional Coatings - Linear Chain Molecules

Conventional Coatings:
- Low crosslink density equals;
- Poor long-term weathering
- Poor chemical resistance
- Poor scratch resistance
- Poor cleaning properties

Nanovere Nanocoatings - 3D Molecular Architecture

Vecdor & Nano-Clear Benefits:
- High crosslink density equals;
- High scratch resistance
- High chemical resistance
- High UV resistance
- High abrasion resistance
- High chip resistance
Nano-Clear & Vecdör Nanocoatings

Multi-Functional Nanocoatings with Remarkable Properties

High Crosslink Density
- Dendritic Polymer Architecture
- Remarkable Flexibility
- Polymer Customization
- Polymer Building Blocks
- High Scratch Resistance
- Coating Customization
- Polymer Additive PE...

Self-Cleaning Properties
- Ice Repellency
- Oil & Dirt Release
- Hydrophobic to Super Marker Release
- Brake-Dust Release

Application Parameters
- One & Two Component
- Conventional, HVLP, Rotary
- Low Viscosity
- 50-100% Solids Formulations
- Plastics, Metal, Powder & Wood
- Solvent, Waterborne & UV Cure

Weathering
- Dendritic Polyurethane
- High UV Resistance
- High Crosslink Density
- Ease of Cleaning
- High Chemical Resistance
BMW is the leading provider premium products and premium services for individual mobility.

**Technical Challenge**
- Improve Scratch Resistance: Full Car & PC Lenses
- Improve Gloss Level: Full Car
- Looking for Competitive Coating Advantage over Mercedes
- Improve Brake-Dust Resistance for Wheels

**Solution:** Phase I & II Development Testing – Nanovere nanocoatings for BMW have exceeded all scratch, mar and chemical resistance testing. Vecdor VV92 performed significantly better than PPG’s CeramiClear and BASF OEM clear coatings in terms of scratch and gloss. BMW validated Nano-Clear for Autobody (VV39.10) to have highest gloss levels and DOI of any clear coating system ever tested.
Accuride is the leading manufacturer of truck wheels systems and other components to the transportation industry. Accuride produces 2M wheels/year.

**Technical Challenge**
- Improve Corrosion Resistance
- Improve Chip Resistance
- Improve Clean Ability
- Improve Chemical Resistance

**Solution:** Nanovere developed the first ever dendritic powder coating and 2K self-cleaning clear and white topcoat which adheres directly to aluminum and steel. Accuride validated that Vecdor & Nano-Clear liquid nanocoatings outperformed Valspar powder coating and PPG’s acrylic e-coating in areas of chip, chemical, corrosion and cleanability.
As a division of Ingersoll Rand – Club Car is the world’s largest manufacturer of electric vehicles. With zero emissions, Club Car electric vehicles (available in Club Car golf cars, Carryall utility vehicles and LSVs, XRT UTVs, and our Villager and TransPorter transportation vehicles) offer a cleaner, quieter alternative to gas without sacrificing performance.

Technical Challenge

- Reduce Warranty Claims
- Reduce Surlyn Plastic Cost
- Improve Clean-ability & Customer Satisfaction
- Improve Long-Term Gloss Retention

Solution: Nanovere worked with Club Car based in Augusta, GA to determine the business and technical requirements. Club Car is currently purchasing Surlyn injection molded polyethylene at premium from DuPont. This plastic material is utilized on most Club Car vehicles. Issue: Surlyn is too expensive, brittle, has poor scratch resistance, water spot staining and poor clean-ability. Nanovere developed Nano-Clear 1K for Autobody and Vecdor 2K clear coating systems and Nanovere VV-100 plastics adhesion promoter for Club Car over HDPE and Polycarbonate.

Result: Club Car validated that Nano-Clear for Autobody adheres directly to Surlyn plastic and dramatically improves surface scratch resistance, golf ball chip resistance and clean-ability.
Mercury Marine is the world’s leading manufacturer of recreational marine propulsion engines. A $2 billion division of Brunswick Corporation (NYSE: BC), Mercury provides engines, boats, services and parts for recreational, commercial and government marine applications.

**Technical Challenge:**
- Improve Long-Term Corrosion Resistance
- Improve Chip Resistance
- Improve Clean-Ability (barnacles)

**Solution:** Nanovere developed a 2K clear coating for Mercury with self-cleaning properties (water, dirt, oil and algae repellency). Nanovere is working with Henkel US surface pre-treatment TecTalis MC2 (filiform corrosion resistance) to provide a total coating solution.

**Result:** Mercury has performed 24 months of corrosion testing thus far with no sign of corrosion. Henkel USA & Nanovere are jointly working on other initiatives over aluminum.
Boeing is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft combined.

**Technical Challenge**
- Reduce Coating Processing Time
- Reduce Maintenance Cost & Time
- Improve Clean-Ability
- Reduce Ice-Adhesion & Deicing Material Cost
- Improve Chemical & Corrosion Resistance

**Solution:** Nanovere has worked with Boeing since 2009 to develop coating systems which provide de-icing properties, higher chemical resistance and reduced surface maintenance cost. Phase I, II & III Development Testing – Nano-Clear for Aerospace passed all scratch, chemical resistance (Skydrol 500), rain erosion and ice repellency testing. Nano-Clear performed significantly better than PPG’s Desothane and Akzo production coating systems.

**Next Steps:** Boeing has expressed interest in Nanovere working with a global paint supplier to support global requirements.
Industrial Case Study

Sveza-Less OOO is the largest birch plywood manufacture in the world. In 2009, Sveza-Les OOO set out to identify the world’s leading nanocoating company to begin the exploration process to benefit clients. Nanovere Technologies was identified as that company and a joint development agreement was thereafter formed in 2011 with Sveza. Nanovere was given the stringent technical task of developing a specialized UV coating system for Sveza with many outstanding properties:

- 100% solids one-component UV coating with no solvents or VOC
- One coat application process which is aligned with the current Sveza environment
- Highest scratch resistance in the marketplace to withstand nails
- Highest chemical resistance in the marketplace to withstand industrial chemicals
- Excellent adhesion to withstand chipping, drilling, nailing and sawing
- Excellent weathering to withstand intense UV rays and non-yellowing properties
- Excellent water & moisture resistance to withstand swelling of the wood
- Highest ease-of-cleaning properties to include cement, water, oil, ice and dirt repellency

Nanovere is pleased to announce the finalization of the first phase of our joint development agreement. We have achieved the physical properties as outlined above within the timeframe allowed. The exclusive product named Vecdör VV90.20E RC has been demonstrated to Sveza and undergone extensive testing.