

American NanoMyte™

A Subsidiary of NEI Corporation

Anti-Corrosion Coatings

Corrosion inhibiting chromate-free nanocomposite pretreatments and nanoparticle primer additives for structural metals

*U.S. Army Corrosion Summit 2009
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Clearwater Beach, Florida*



Report Documentation Page

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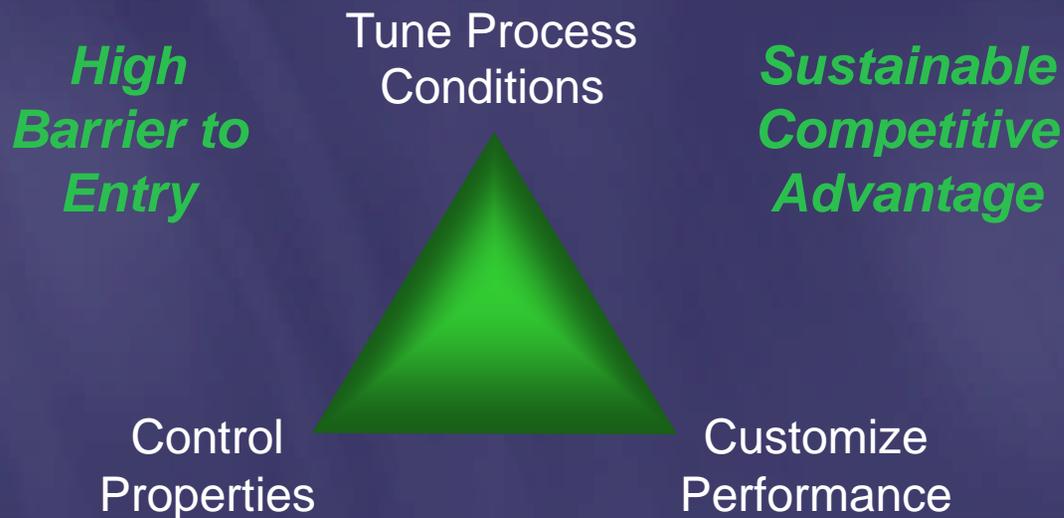
NEI Corporation Spins Out American NanoMyte (Formerly NEI Corrosion Technologies)

- **Experience** in developing, manufacturing and distributing nanoscale materials for a broad range of customers around the world.
- **Expertise** in nanoparticle synthesis, surface modification and coatings, and nanotechnology-based formulations.
- **Nanomyte™** line of products, developed by creating nanostructures and modifying them through novel chemistry, fall into two broad categories:
 - Additives** - nanomaterials tailored to meet the specific performance and manufacturing requirements of our customers
 - Alternates** - nanoscale counterparts of microscale materials



Small Technology for Big Applications

Nanotechnology enables control of matter and material properties at the nanometer scale



American NanoMyte's Mission

- Use NEI's proprietary nanotechnology to create custom products that meet or exceed the demanding anti-corrosion requirements encountered in diverse military and commercial (dual-use) applications:

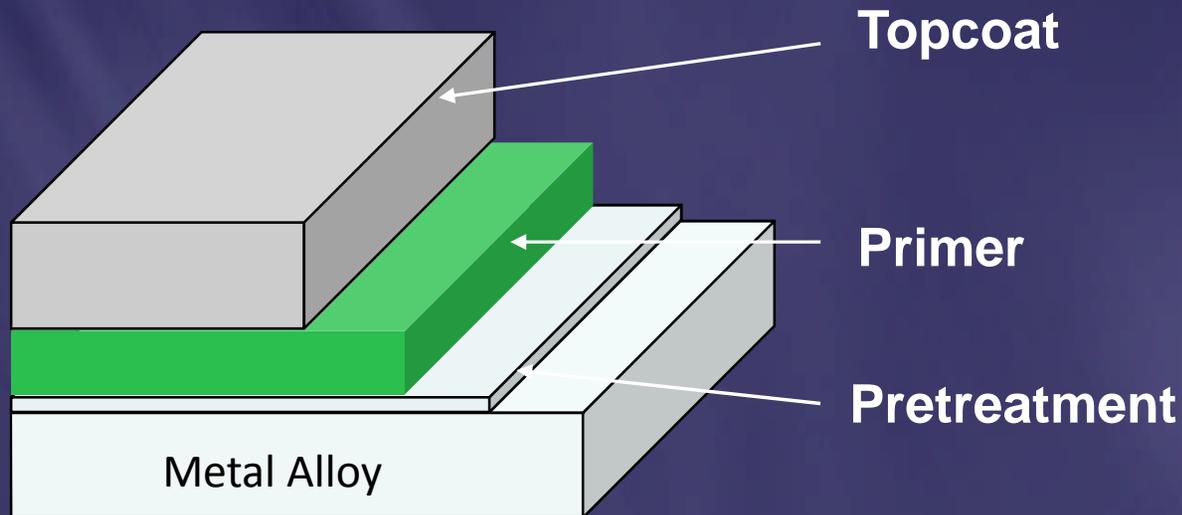
Aerospace ▪ *Marine* ▪ *Automotive* ▪ *Industrial* ▪ *Construction* ▪ *Medical*



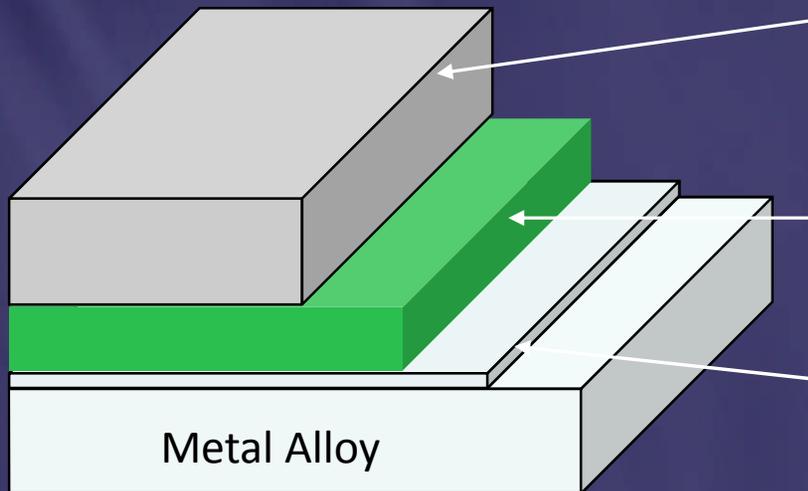
- Leverage and build on NEI's unique abilities to functionalize inorganic nanoparticles and disperse them in organic (polymeric) matrices to create nanocomposite (hybrid) structures for anti-corrosion applications
- Continuously strive to provide value to our customers by offering differentiated nanotechnology-enabled products that solve their relevant corrosion problems



Corrosion Protection Coating Components



American NanoMyte's Coating System



Self-Healing Topcoat

UV protection, scratch resistance and aesthetic appearance

Chromate-Free Primer

Corrosion protection

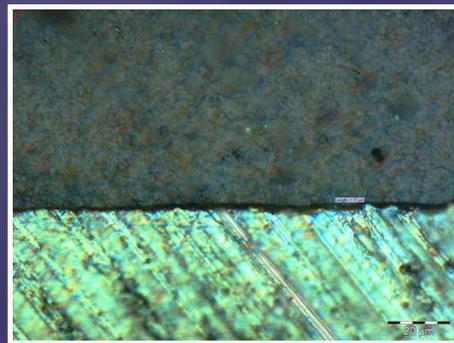
Self-Healing, Chromate-Free Pretreatment

Adhesion and corrosion protection



Nanomyte™ Anti-Corrosion Coatings: Focus on Pretreatments and Primers

- Chromate-free conversion coatings and coating additives
- Formulations designed to inhibit corrosion in lightweight metals (aluminum, magnesium) and steel alloys
- Provide exceptional adhesion strength and barrier protection
- Exhibit self-healing (damage responsive) behavior



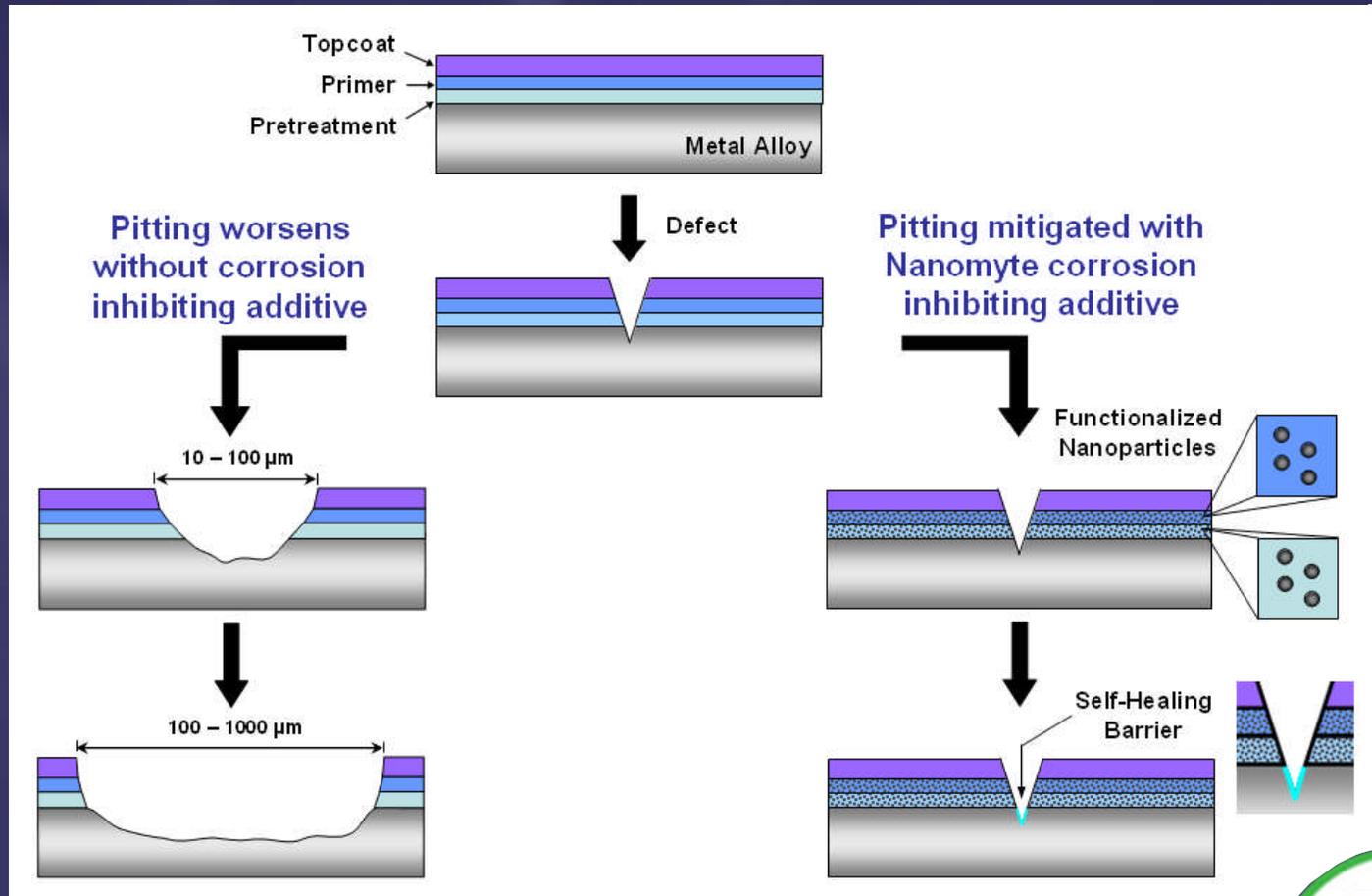
← Primer

← Pretreatment (0.5-2 μm)

← Metal Substrate



The Nanomyte Advantage: Chromate-Free, Self-Healing Barrier Coating Inhibits Corrosion



The Opportunity

- **Increase use of lightweight metals**
 - Aluminum and magnesium alloys
 - More prone to corrosion
- **Phase out chromates**
 - Carcinogen
 - Exposure limits reduced from 50 to 5 $\mu\text{g}/\text{m}^3$
 - No suitable alternative to chromate conversion coating
- **Extend life of coatings and metal parts**
 - Need for self-healing non-chromate conversion coatings
 - Reduce environmental concerns (eliminate abrasion blasting)
 - Push paint rework out in time (improve abrasion blasting)



Nanomyte Pretreatment Products

- Nanomyte™ PT-10 for aluminum alloys
- Nanomyte™ PT-15 for magnesium alloys



Nanomyte Pretreatment Performance

ASTM B-117 Salt Spray Test

- Pretreatment only – Metal surfaces remain bright with no corrosive degradation observed
- Pretreatment + Primer – Pass 2,000 hours of the test

ASTM D-3359 Tape Adhesion Test

- Pretreatment significantly improves adhesion between metal and coating

ASTM D-522 Bend Test

- Pretreatment does not affect flexibility of primer coatings



Nanomyte PT-10 on Aluminum



Nanomyte pretreatment shows no visible sign of corrosion compared to chromate

Pitting
Corrosion



Chromate
Standard

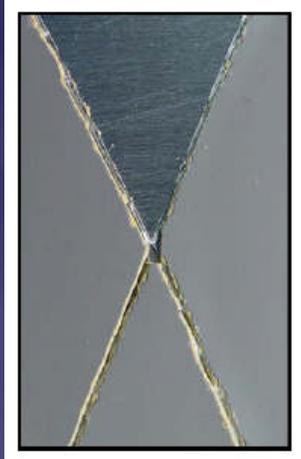


Nanomyte
PT-10

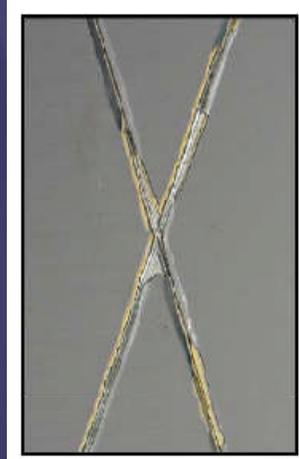
Salt water immersion of aerospace
aluminum for 2 weeks



Significant improvement of adhesion between aluminum and primer coating



Coating applied over non-abraded aluminum alloy



Coating applied over abrasion blasted aluminum alloy



Coating applied over Nanomyte PT-10 pretreatment

ASTM D-3359 adhesion test on marine aluminum.
Panels soaked in water for 24 hrs at 37°C before the test.



Pretreatment significantly enhances adhesion after 4 weeks in salt spray test



Primer and topcoat delaminate on untreated aluminum panels



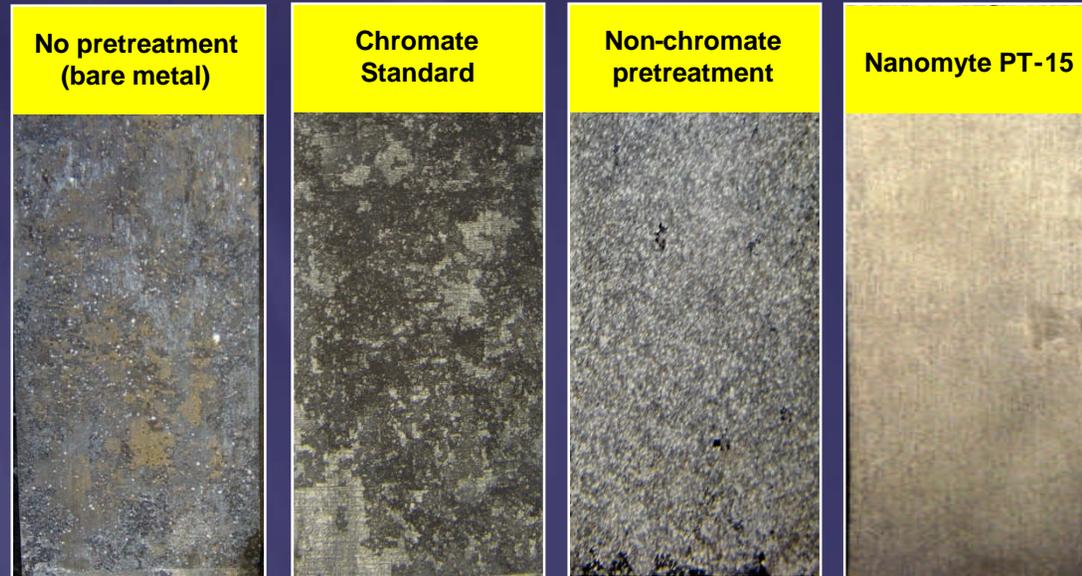
Primer (yellow) remains intact on Nanomyte PT-10 treated aluminum panels



Nanomyte PT-15 on Magnesium



Nanomyte has better corrosion resistance than non-chrome pretreatment



Pretreated magnesium panels after salt water immersion for 120 hours

NOTE: The black discoloration on the chromate sample is a protective oxide film that protects Mg from corrosion



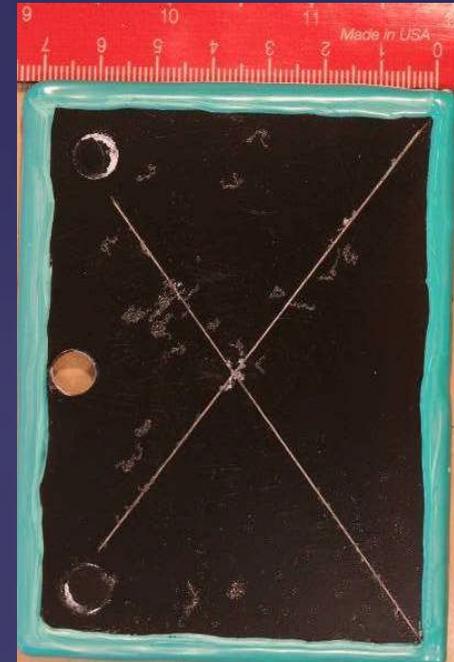
Nanomyte PT-15 performs well on E-coated Mg panels after 6 weeks in salt spray test



Untreated Mg



Non-Chromate Std.



Nanomyte PT-15



Adding nanoparticles to primer reduces blistering on Mg in salt water immersion test

Blister



Primer without nanoparticles

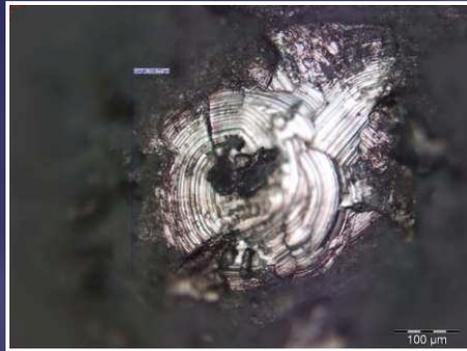


Primer with nanoparticles

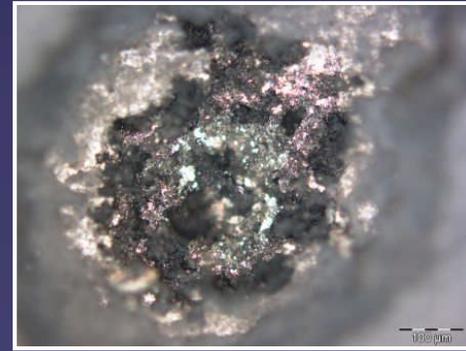


Optical micrographs of artificial defect: Primer with nanoparticles shows corrosion inhibition

Substrate:
Mg AZ91D



Primer as is
Before salt water immersion

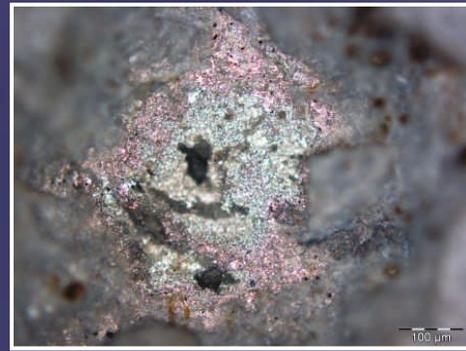


Primer as is
After 48-hr salt water immersion

**Corrosion
observed**



Primer with nanoparticles
Before immersion in salt water



Primer with nanoparticles
After 48-hr salt water immersion

**No
corrosion**



Summary: Nanomyte Pretreatments

- Nanomyte chromate-free pretreatments inhibit corrosion on aluminum and magnesium as well as other non-chromate products and may be able to replace hazardous chromate conversion coatings.
- Formulations are compatible with conventional coating methods. The pretreatment generally forms a thin layer with a thickness of 0.5 - 2 microns. It provides excellent adhesion to the primer and barrier protection, in addition to inhibiting corrosion through self-healing.
- An additional advantage of our pretreatment is the elimination or augmentation of physical surface preparation via abrasion blasting prior to chemical coating. This process improvement can result in significant savings and benefit to the user.



Summary: Nanomyte Primers

- Functionalized nanoparticle additives are being developed that can be easily incorporated and dispersed into primer coating formulations in the same manner as conventional corrosion inhibiting pigments.
- The additives are completely chromate-free and economical, potentially allowing for the use of a thinner primer coating.
- American NanoMyte can work with you on your specific primers to introduce corrosion inhibiting functionalities.



Business Partnerships Add Value

- We provide value by customizing solutions and seamlessly integrating our nano-engineered materials into customers' products.
- We are currently seeking development partners for our anti-corrosion coatings. Sample requests are welcome.



Two-Step Approach to Collaborative Product Development

- (1) First we engage with customers in a simplified technical development program at low cost and with short time frames to develop custom solutions for their specific end-user applications.
- (2) Concurrently with the technical initiative we work with business development staff to formulate long term Business Agreement options.

Common business relationships that we typically consider include:

- Supply of tonnage quantity pretreatments and primer-additives
- License manufacture of pretreatment and primer-additives to you
- Transfer intellectual property via a one-time sale



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