**MOLECULAR REBAR® for Coatings**

*Increased performance for the coating industry using carbon nanotubes*

- Reduced cost of ownership
  - Longer coating lifetimes 2-3 times
  - Increased damage tolerance
  - Reduced labor and coating cost long-term

- Reduced coating cost
  - Thinner coatings possible
  - Reduced corrosion inhibitors like Zinc dust
  - Possible 3 coats reduced to 2 coats
Molecular Rebar Design – Who We Are

• Established in 2009, to develop and commercialize a breakthrough form of discrete, surface modified multiwall carbon nanotubes (MWCNT’s), called MOLECULAR REBAR® (MR)
• R&D and Manufacturing based in Austin, TX including 100 tonne capacity, ISO 9001:2015 certified plant
• 69 Active Patents
• Fast-growth thru commercial partnerships for targeted markets for MOLECULAR REBAR®
  • **Black Diamond Structures**: former JV with SABIC. Energy storage, commercial globally in Li and Pb batteries
  • **Peak Nano**: Defense/Military applications
  • **Biopact Ventures**: Targeted biomolecule delivery into cells
  • **MECHnano**: Additive manufacturing (3D printing)
Carbon Nanotubes - History

Discovered in 1991

- Heralded as the “Next Revolution in Material Science” (Smalley, Rice University)
- An incredible amount of money spent (including $35 billion by the US government) with modest results in the first 20 years after discovery

Major Technical Issues

- Carbon Nanotubes (CNTs) clump together into non-uniform, “cross-linked” bundles as they are created
- Extremely difficult to disperse uniformly with much dusting causing environmental and health issues
- “Micro-clumps” not very valuable in most applications

A nano tube is 10 thousand times smaller than a human hair, a bundle is about 10 times smaller than a human hair.

1 - 10 micron bundle has 6,000,000 individual tubes
Molecular Rebar® (MR) Technology

MRD creates functionalized and discrete (individual) multi-walled, carbon nanotubes (MWCNTs).

External Purchase of MWCNT’s → Detangle → Formulation - Dispersion → Master Batch Concentrate → Customer Integration into End-Product

Clumps of entangled CNT’s → Clean, Discrete Nanotubes

MICRON SIZED → NANO SIZED and HIGH ASPECT RATIO

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MOLECULAR REBAR® (MR)

• MOLECULAR REBAR® means:
  • Discrete or individual nanotubes
    • High aspect ratio; ‘fibers’
  • High purity
    • Lack of catalytic residue
  • Chemical functionalization
    • Basis for dispersion quality
    • Good interaction with paint and epoxy thru -COOH
  • Molecular-scale reinforcement
    • Like metal rebar in cement, but for coatings
MOLECULAR REBAR® vs CNT Bundles in Epoxy

- Excellent dispersion of MR
- No agglomerations causing defects
- Very low catalyst residues

- Inhomogeneous distribution of CNT
- Agglomerations/bundles (poor strength)
- High catalyst residues
Benefits of Molecular Rebar®

• **Mechanical or structural improvements to materials (melting points < 500C)**
  - Tear, impact, toughness and crack improvements
  - Reduced co-efficient of expansion and contraction
  - Improved adhesion and other surface phenomena
  - Control of crystal and microstructures
  - Strength and modulus

• **Transport properties**
  - Heat and electrical
  - Network forming, control of microstructures
  - Ion and molecular transport and storage

• **Electromagnetic fields effects**
  - Absorptions and reflections that can be controlled
  - Fields affect MR and MR effects fields

*Combinations of the above (i.e. high adhesion and toughness)*
Patent Strategy

• MRD owns patents, licenses rights
  • Licensee has available any claim in any patent for use in their field
• Global coverage
• Composition of matter for Molecular Rebar® (MR), blends, special formulations
  • Second version of basic composition patent now granted allowing for about 18 more years of protection (2037) for base material
• Applications in general markets
• Very integrated coverage
• Knowledge flow throughout user community
MRD Patents

- MRD has 69 Active patents with about 65 more in the patenting process
  - Examiners across the globe verify MRD has unique technology
  - Key patents are for composition of matter meaning no matter how a competitor makes mostly individual, discrete tubes alone or in blends, they will likely infringe MRD patents
- Process knowledge is in the form of Trade secrets and know how
- For key market applications MRD usually has 3 layers of protection with composition of MR, formulations of MR and application
MRD IP Protected by a Strong Patent Portfolio

- Extensive number of composition of matter patents
- Coverage extends to 2037 for MR itself
MOLECULAR REBAR® - The Technology Advantage

Benefits MR Can Bring in Coatings
• 2-3X improved corrosion resistance
• Increased adhesion by 50%
• Improved impact resistance by 67%
• Improved durability and abrasion resistance
• For zinc rich, less zinc, less weight, better coating

MR Works by:
• Increased cathodic protection (Zinc rich primers)
• Increased adhesion and toughness
• Reduced water uptake
MOLECULAR REBAR® Product Forms

MOLECULAR REBAR® in Xylene - Wet Cake
- 8% MR in xylene – solid/bead-like form
- Add into commercial solvent borne coatings during normal mixing
- Typically adds <1% additional solvent volume
- For coating/paint users/applicators

MOLECULAR REBAR® in Epoxy – Master Batch
- 2% MR masterbatch in EPON828
- Replace a portion of epoxy when formulating a coating
- For coating/paint producers

MOLECULAR REBAR® in Water – Aqueous
- 3% MR in water – pours just like water
- Replace a portion of water when formulating water borne coatings
- For coating/paint producers
Performance in Coatings Applications

MOLECULAR REBAR® has been tested in a range of coatings with partners

- 1, 2, and 3-coat systems
- In zinc rich primers, mid-coats, 1-coat with corrosion inhibitors (organic and inorganic), water borne rubberized coatings etc.
- Marine, protective, machinery, construction
- MR is black or grey so color can be an issue to work

MOLECULAR REBAR® in coatings formulations

- Designed to be added to coating materials using existing equipment with almost no change to procedures
- For applicator use of existing personal protective equipment and clothing is sufficient
- Cleanup and spills are handled the same way as now
- There is no airborne MR in applying, use and grinding of epoxy with MR as MR does not come off epoxy
Protective/Marine: Wet Cake in Commercial Primers

- Direct addition to existing coating formulations prior to application
- Improved Performance of Commercial Formulas demonstrated – example

- PPG Amercoat® 68HS 3-component system used
  - Only 0.025% MR on dry basis added on the total formulation weight basis
  - MR-Xylene Wet Cake used
  - Mixed using the same manufacturer instructions and standard power mixer
  - <1% additional solvent volume added to the final primer
  - Should be diluted with solvent as done normally
Protective/Marine: Extended Protection for Zinc rich Primers, Salt Fog Testing

- **0.025% Molecular Rebar®** (total formula weight basis)

- **Control - Blank**

- **300 hrs**
- **600 hrs**
- **900 hrs**
- **1200 hrs**

- Three-Component commercial Zinc Rich Epoxy Primer (>80% Zinc) – PPG Amercoat® 68HS
- Molecular Rebar® Added During Typical Mixing
- Substrate: Q-PANEL S-48 Ground Steel
- 50 microns D.F.T., no top coat
- Internally mixed, applied, and tested
Internal: 1-Coat Coating, MR Improves Adhesion in Cathodic Disbondment Tests

• Samples scribed and electrochemically biased at -1V vs. sat. Ag/AgCl for 24 hrs. in 5% NaCl solution
  • Simulated cathodic corrosion
• Tape was then applied, detached coating area removed. Images were analyzed for the area removed.
• MR: 391 system: **25%** reduction in area removed; 550 system: **56%** reduction in area removed
Comparison to the Competition - MR versus Teslan

<table>
<thead>
<tr>
<th>Attribute</th>
<th>MOLECULAR REBAR®</th>
<th>Teslan® (Tesla Nanocoatings)</th>
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</thead>
<tbody>
<tr>
<td>CNTs to improve commercial zinc-rich primers</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CNTs to improve lifetime of coating 2-3 times</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>CNTs to reduce coatings from 3 to 2</td>
<td>?</td>
<td>✓</td>
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</table>

MOLECULAR REBAR® is a drop-in additive that the paint user or coatings formulator can directly use. It is positioned to extend coating lifetime 2-3 X and impact 50-100%.

Tesla Nanocoatings positioning is to eliminate 1 out of 3 coatings but at a high cost of ~$200/gal.

MRD is confident it can design a two-coat replacement for three-coat systems.

The competition makes only zinc-rich primers/topcoat with CNTs.

MOLECULAR REBAR® allows you to get the benefits of CNTs in any coating.
MOLECULAR REBAR® for Coatings – Summary of Benefits

- Reduced long term cost of ownership
  - Longer coating lifetimes
  - Increased damage tolerance
  - Reduced labor costs – for a 2 times normal painting cycle only 1 Coat of MR is needed – saving the cost of prep, application and paint
  - Less premium for MR addition
  - Less risk of incidents both safety and environmental

- Reduced coating cost
  - Thinner coatings
  - Reduced corrosion inhibitors like Zinc dust

- Can be a Field addition to Commercial Coatings
  - Easy handling, safe and adaptable system

- Green!
Penetrating the North American Market for Oil and Gas, Marine, and Petrochemical Coatings – Indicative Structure

- To start a faster penetration of the market, the first market efforts will be to directly sell to end-users.
- A Distribution Partnership including 3 coating experts who are in the oil/gas business will be formed.
- The territory will be North America with target markets oil/gas, EPC and marine.
- Using personal contacts develop oil majors, a platform operator, a ship owner and EPC contacts to start selling into the markets as a value sell.
- MRD receives 70% of net income, distributors the balance.
- There is a 20% of net income set aside as an accrual to cover any warranty issues (could be replaced by insurance in the future).
- Each partner pays their own costs.
- Partnership sells additive which is based on Xylene (other solvents including water are possible) as O/G, Marine and EPG industry uses solvent based coatings.
Marketing for Distribution Partnership

- Industry is looking for new technology to cut their long-term costs related to control of corrosion
- Selling proposition is to reduce total cost of ownership related to prevention of corrosion using corrosion coatings—
  - How many times will the facility over its lifetime need to be repainted including preparation, coating labor and the coatings costs
  - Calculate the same cost using twice the life of the coating and with doubling the price of the paint
  - Calculate the value creation using MR compared to today’s approach
- Use partners to persuade the oil industry to try the coatings
- Guarantee extra lifetime at 2X by rebating cost premium of MR paint
  - Set up a warranty accrual fund for any issues, reverse with 2X lifetime performance
- Use industry events and meetings to drive home the message
Estimated Sales and Revenue Forecast for Distribution Partnership

- 4 initial market application with customers
  1. Oil and Gas Market - Major oil and gas producer such as BP, Exxon, Chevron etc.
     1. Only 2 used in estimate
  2. Platform Operator - Platform operator who has 444 platforms in Gulf of Mexico
  3. Ship operator who has 200 ships from 90-525 feet long
  4. Major EPC user

- Each category participant wants this type of technology and the Distribution Partnership has a relationship with the leadership to drive this type of new technology

- The value is assumed to be a 100% upcharge on the paint with the savings of labor going to the end user

- The MR additive will be applied into existing paint purchased from paint companies and added before solvent is added
Estimated Sales and Revenue Forecast

- These estimates are for a reasonable ramp-up for a fraction of the market with just the initial customers for the Distribution Partnership.
- A warranty pool at 20% of gross margin is included – reversible in the future based on performance.

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
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<tbody>
<tr>
<td>Oil &amp; Gas Market</td>
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<tr>
<td>Platform Market</td>
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<td><strong>MRD Margin</strong></td>
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<td><strong>$266,666</strong></td>
<td><strong>$515,000</strong></td>
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</tbody>
</table>
Joint Venture or Sale of Technology by MRD – Indicative Structure

- Would include Distribution Partnership on whatever terms partnership was formed for the focus markets
- Worldwide with all coating applications
- Would include ability to sub-license
- MRD would want a 2% royalty to maintain IP portfolio from which rights would be granted or licensed
- In due diligence, there are results of many trials adding MR to epoxy and then formulating with water and solvents, a flexible approach on product form is possible
- Investment for launch at this scale will be $2.5 million with cash positive projected in year 4
- A joint development effort or license to develop or purchase this technology are options
  - An option to purchase or license is a possibility