

# Advanced Nanostructured Powders For Cold Spray Applications

Presented By

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To

The ISCo Consortium Sponsors

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# Eltron Overview

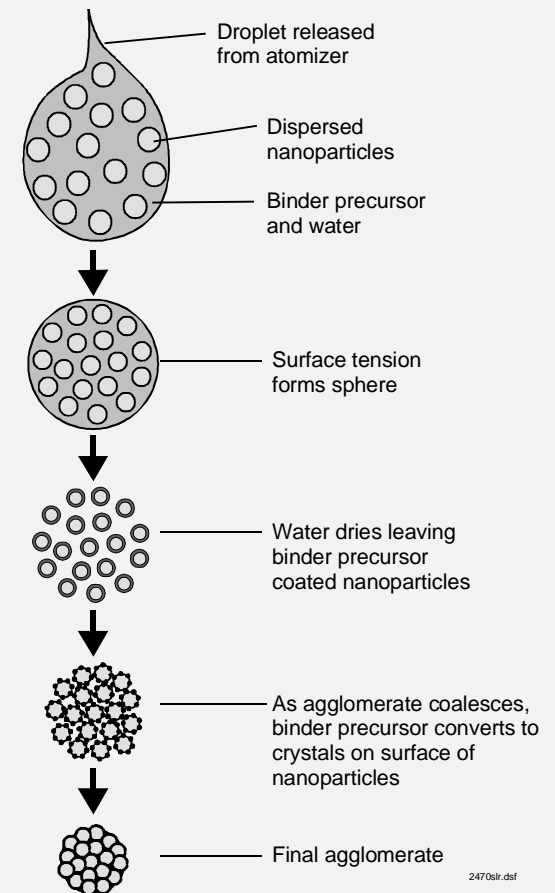
- Company history
- Approximate annual revenue is \$10 million
- Government/commercial ratio is 70/30 (averaged over 5 years)
- Key Business Sectors
- Examples of commercialization success:
  - 29 patents licensed
  - Phase III Development of Hydrogen Membrane
  - Phase III Development of Hydrogen Peroxide Generator – Spin-off company Eltron Water
- 25,000 ft<sup>2</sup> research facility in Boulder, Co
- Wide range of instrumentation
- Small (0.5 kg/h) and Large (1-15 kg/h) Spray Drier Systems with Air or Inert Gas Control
- Contract Research and Development
- As of August 2011, DCAA performed an audit and approved our financial system as being compliant. DCMA concurred with the audit by DCAA.



**For 30 years, Eltron has invented technologies to meet the needs of current and emerging markets.**

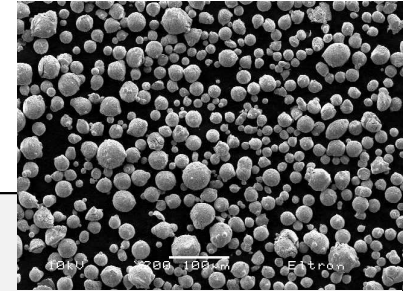
# Project Description

- Advanced Nanostructured Powders for Cold Spray Applications
- SBIR Phase II project sponsored by the Army Research Laboratory
- Topic A08-068 - Cold Spray Nanostructured Powders
- Funding to date: DOD SBIR Phase I and II (Army)
- Currently TRL-6 & MRL-4



Spray drying is a well-established, scalable technology used widely in food and catalyst industries.

# Project Snap-Shot



## Project Summary:

- Phase I (Proof of Concept)
  - Deliverable: Produced 3 powder compositions for the Army Research Laboratory
- Phase II (Scale-up to 10 lb/day) - Current
  - Produce 7 powder compositions for cold spray at ARL
  - Determine probabilistic techno-economics
    - P10/P50/P90
    - Powder costs at current and future scale
  - *Technical:*
    - Develop densification treatment
    - Characterize agglomerates
  - *Voice of Customer (VoC):*
    - Interest in Al alloys
    - Powder flowability
    - Optimal particle size distribution
- Phase III (Scale-up to 100 lb/day): Need funding
  - Update techno-economics
  - *Technical:* Drive development plan based on tornado plot prioritization. Key variables include:
    - Nanoparticle costs
    - Nitrogen costs

## Top Priorities / Issues:

Techno Economics



- Tornado (P90, P50, P10) drives plan focus
- Determine powder costs for 100 lb/day system

Technology & IP



- By end of Phase II, 10 powder compositions will have been produced
- IP:
  - Metallic binder
  - Densification treatment
- Produce full batch using low-cost, secondary method.
- Quantify powder costs from secondary method, anticipate \$20/lb.

Partners



- Development Partner
- Cold spray - ARL or contract spraying
- Powder toll manufacturer - Phase III
- End-user

## Key Item Time Line

11/2012



First batch sprayed at ARL

12/2013



End of Phase II

**By end of Phase II, 7 of Eltron's agglomerate batches will have been cold sprayed by ARL.**

# Technical Solution

## Nanostructured Agglomerates

- Benefits of Eltron's Agglomeration Process
  - Scalability
  - Applicable to any nanoparticle composition
  - Control of oxide levels
  - Control of agglomerate particle size distribution
  - Nano-phase blending

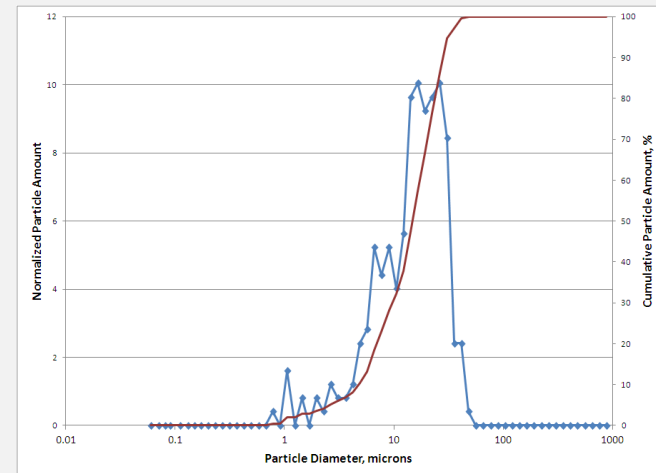
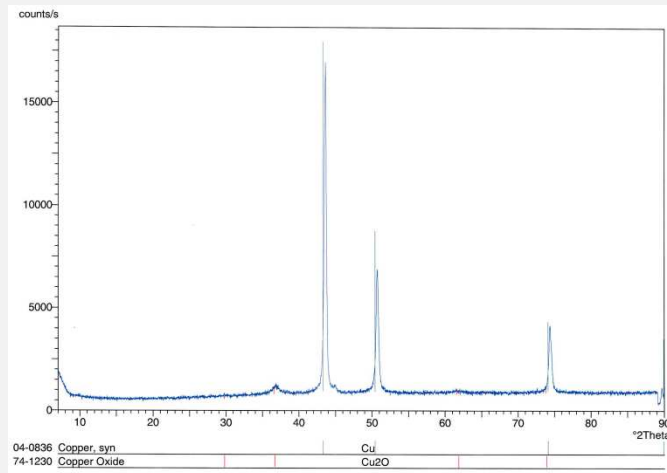
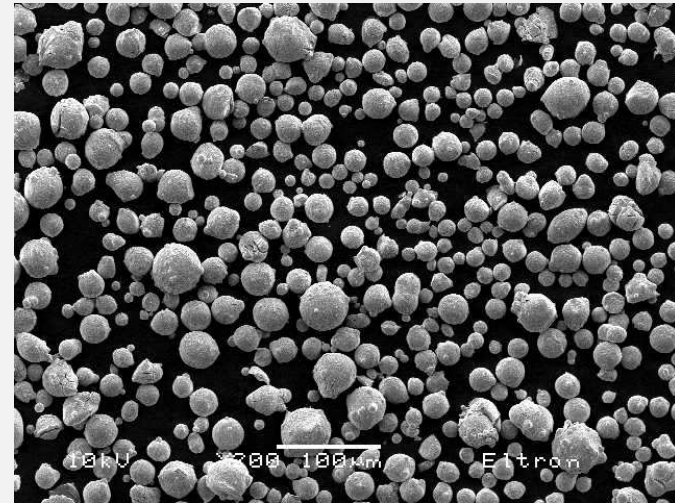
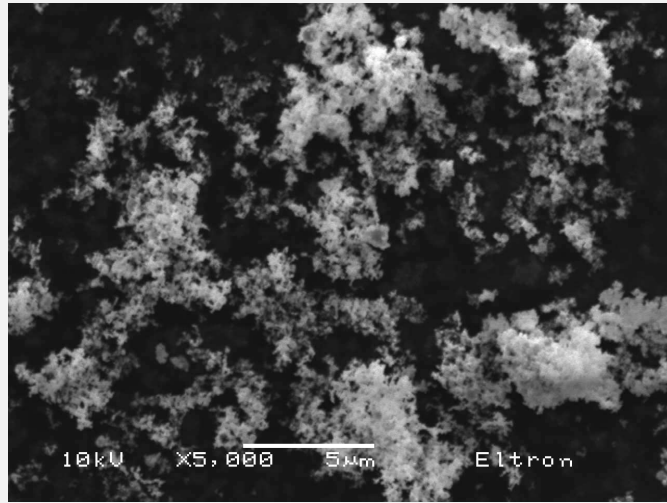
### Superior Properties of Nanostructured Coatings:

- Superior resistance to localized corrosion
- Increased fatigue and erosive wear resistance
- Higher hardness, toughness and strength
- Increased lifetime and durability

**Nanostructured agglomerates will be used to produce nanostructured coatings with superior properties.**



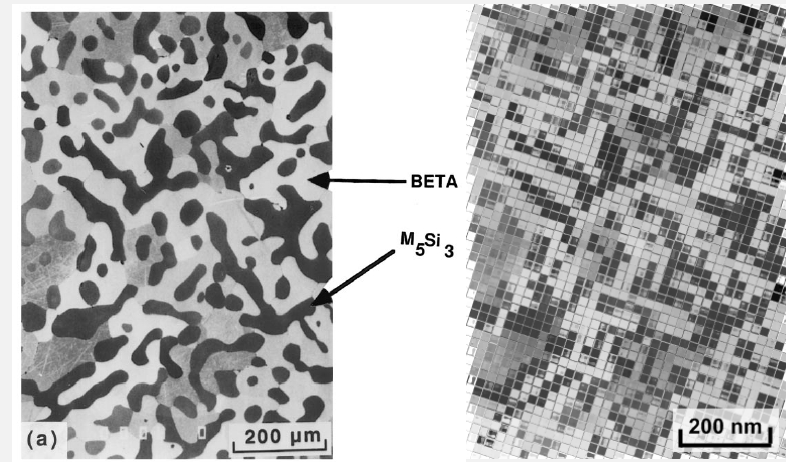
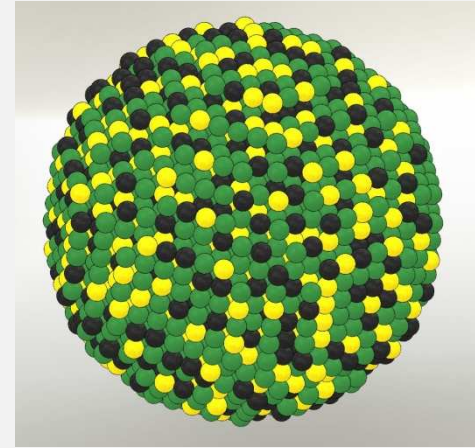
# Progress to Date



**By end of Phase II: 7 compositions will be cold sprayed at Army Research Laboratory.**

# Value Proposition

- Benefits of Cold Spray
  - Penetrating the “shock wave”
  - Achievable Figures of Merit
    - 2X increase in abrasion resistance
    - 2X increase in hardness
    - 4-9X increase in strength
- Unique features of the technology:
  - Scalability
  - Metal binder\*
  - Densification treatment\*
  - Nano-phase blend\*
- Invention disclosure in process



Nanostructured coatings are up to 9X stronger than coatings using conventional powders.

# Applications

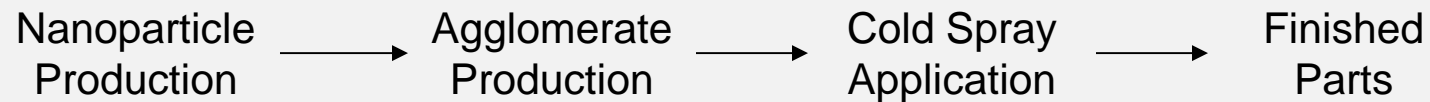
- Customers:
  - Cold Spray
  - Thermal Spray
  - Powder Metallurgy
- Industries:
  - Aerospace
  - Architecture
  - Marine
  - Military
  - Automobile
  - Consumer Products
  - Medical
- Coating Applications:
  - Corrosion Resistance
  - Wear Resistance
  - Antimicrobial
  - Electrically Conductive
  - Part Repair
  - Rapid Prototyping
  - Reactive Materials

Nanostructured coatings have applications in a wide range of industries.



# Value Chain

- Corrosion Resistant Coating Value Chain Example



- Potential Customer Quotes
- Competition:
  - Cryo-milling
  - High energy milling
  - Liquid particle acceleration

Eltron's process offers reduced cost and scalability.

# Technology Roadmap

- End of project: TRL-6 & MRL-4

Develop Agglomeration Technology	Phase II			Develop Nano-phase Blend		Develop Anti-bacterial Composition			
Agglomerate Production			Phase III		Spray Nano-phase Blend			Spray Anti-bacterial	
Cold Spray				Repair Tests		Prototypes of Nano-phase Blend Alloy		Anti-bacterial Coatings	
Repair Aircraft Components					Develop Certification Methods	Lifetime & Flight Testing		Part Repair	
Rapid Manufacturing								Manufacture Nano-phase Blend Alloy Parts	
Time	2013		2014		2015		2016		2017

With quick scale-up, nanostructured coatings could be in use within 5 years.

## Partnering Interests

- Open to broad spectrum of partnering:
  - Licensing through Joint Development
- Phase III 100 lb/day System - \$2 Million
- Alternative development plans

Phase III Activities	1	2	3	4	5	6
Spray Drying - Arrange toll producer						
Produce 100 lb/day agglomerates						
Densification treatment - Arrange toll producer						
Densify powder at 100 lb/day						
Cold spray agglomerates to verify coating properties						

## Next Steps

- Cold spray at ARL
- Techno-economic Analysis
- Involvement in Phase II
  - Help define market of interest
  - Project metrics
- Phase III starting as early as January, 2014.
- Samples for testing at your facility