A bespoke, non-additive approach to antimicrobial coatings

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Inhibit Coatings is a New Zealand technology company that develops advanced materials, founded on the back of Dr Eldon Tate's PhD research under Prof. Jim Johnston at Victoria University of Wellington.

Our next generation of antimicrobial materials improve the wellness of the people interacting with them, while providing a solution that is:

More effective, **longer lasting**, **cost effective**, and **sustainable**.

Inhibit's goal is to provide safe, long-lasting protection for people, products, and the environment.

The Problem

Hospital acquired infections are one of the top 10 leading causes of death in the USA.

Butler, Ashley. *Infection Control Today* (2023).

The estimated direct annual cost of treating HAIs in the United States ranges from $ 28.4 billion to $ 45 billion.

Gidey, Kidu, et al. *Plos one* 18.2 (2023): e0282141.

The Problem

Jensen Farms outbreak

Cross-contamination of bacteria to food from the processing environment

300,000+

CANTALOUPES CONTAMINATED

142

PEOPLE HOSPITALISED

33

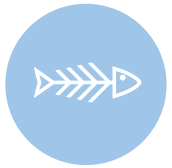
DEATHS

Current Antimicrobial Coatings

The antimicrobial solutions currently available rely on the *controlled leaching of additives* – results in *significant drawbacks*:

Limited Lifetime

They *stop working* when the active ingredient has washed out (days, weeks, or months)



Environmental Impact

Release of toxic active ingredient into waterways and environment

Physical Properties Impact

Only limited amounts of additive can be used before adverse effects on the coating

Inhibit Coatings has unique nanotechnology that has been proven to eliminate these drawbacks

Next-Generation Antimicrobial Technology

Non-leaching: silver is bound directly to the resin

Proven **broad-spectrum** antimicrobial activity

Effective against bacteria, viruses, superbugs, fungi

Safe to use and interact with

Non-toxic, non-irritating, not a sensitizer

Scaleable and **cost-effective**

Two Approaches:

Ready-To-Go Offering

- Waterborne polyurethane – silver composite
- Highly optimized & extensively characterized
- Antimicrobial & leaching data available

Bespoke Solutions

- Customized solution - using your resin system
- Polyurethanes, acrylates, epoxies, polyamides
- Significant advantages over ready-to-go

Two Approaches:

Ready-To-Go Offering

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Bespoke Solutions

- Customized solution - using your resin system
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Advantages of Bespoke Approach

Compatibility between resin and additive

Cost Efficiency

As low as $0.0033 of active ingredient per kg of product

Intellectual Property & **Competitive Advantage**

Supply Chain Reliability & Inventory Management

How it works:

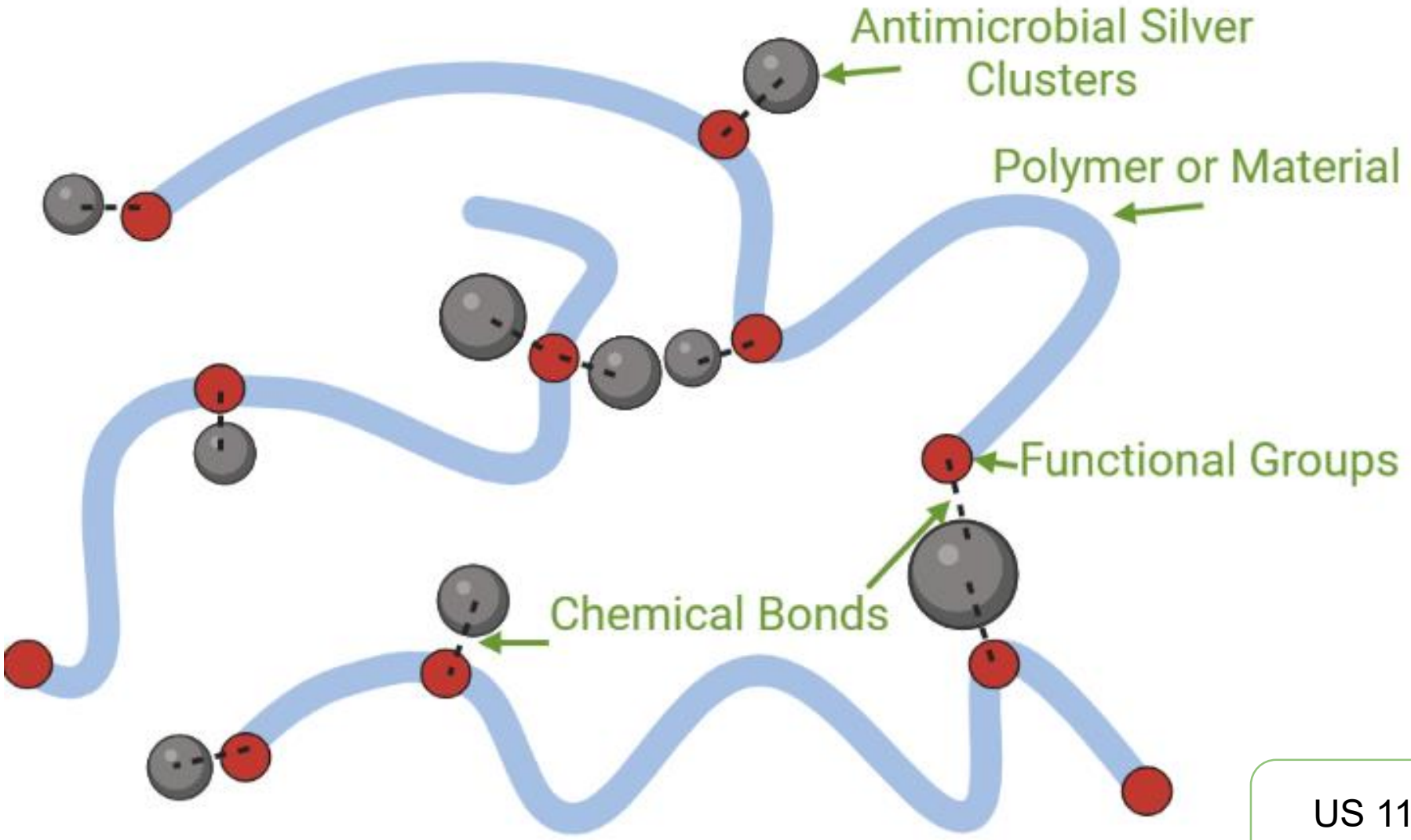
Paint, coating, or other polymer-based system

Apply antimicrobial technology

Base resin used in coating

- Unformulated -

How it works: Application of antimicrobial technology to base resin



US 11,292,922 B2
US 11,292,923 B2

Examples of Functionality Required:

Amines/amides

Carboxylic acids

Esters/Ketones/Aldehydes

Alcohols

Examples of Suitable Resins:

Polyurethanes

Acrylates

Epoxies

Polyamides

Waterborne

Solventborne

100% Solids

How it works:

Paint, coating, or other polymer-based system

Apply antimicrobial technology

Characterization & optimization

Base resin used in coating

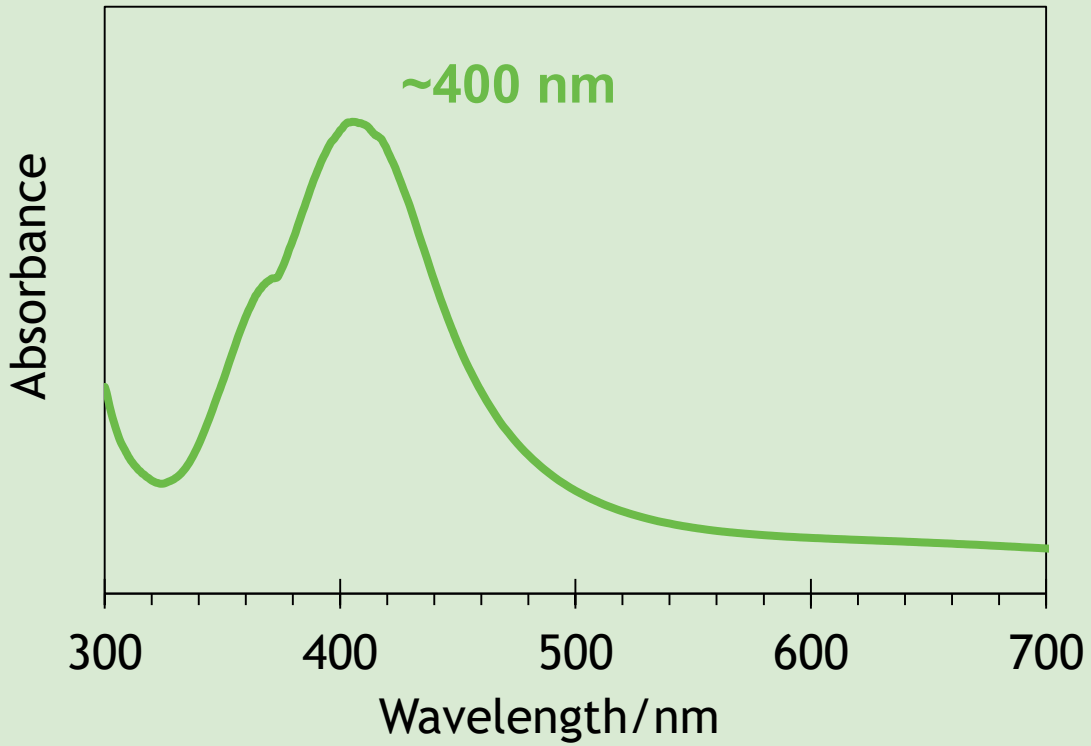
- Unformulated -

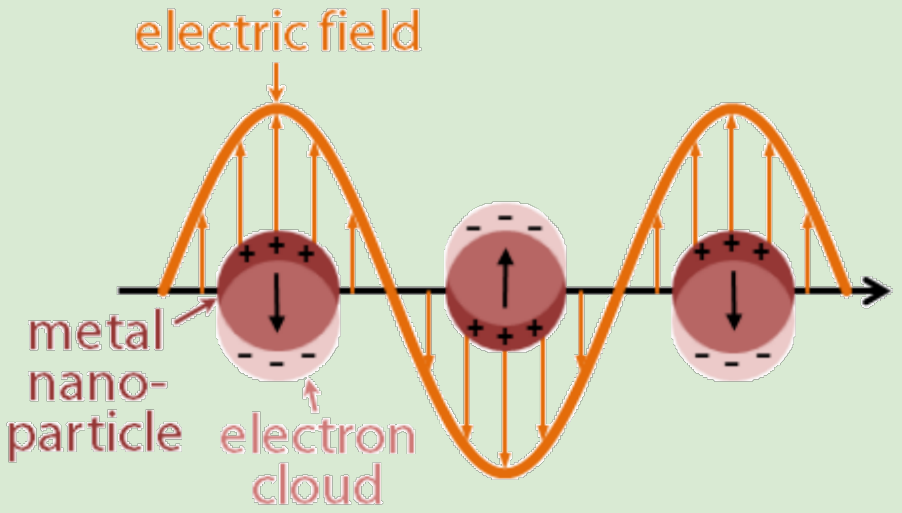
Functionalized, silver-resin composite

Characterization Techniques

UV-visible spectroscopy	Confirm nanoparticle formation Indication of particle size & size distribution
Electron microscopy	Nanoparticle size & distribution through resin
Energy dispersive x-ray spectroscopy	Nanoparticle composition
Silver leaching measurement	Leaching of silver from the composite
Antimicrobial testing	Activity against bacteria, viruses, and fungi

Characterization: **UV-Visible Spectroscopy**

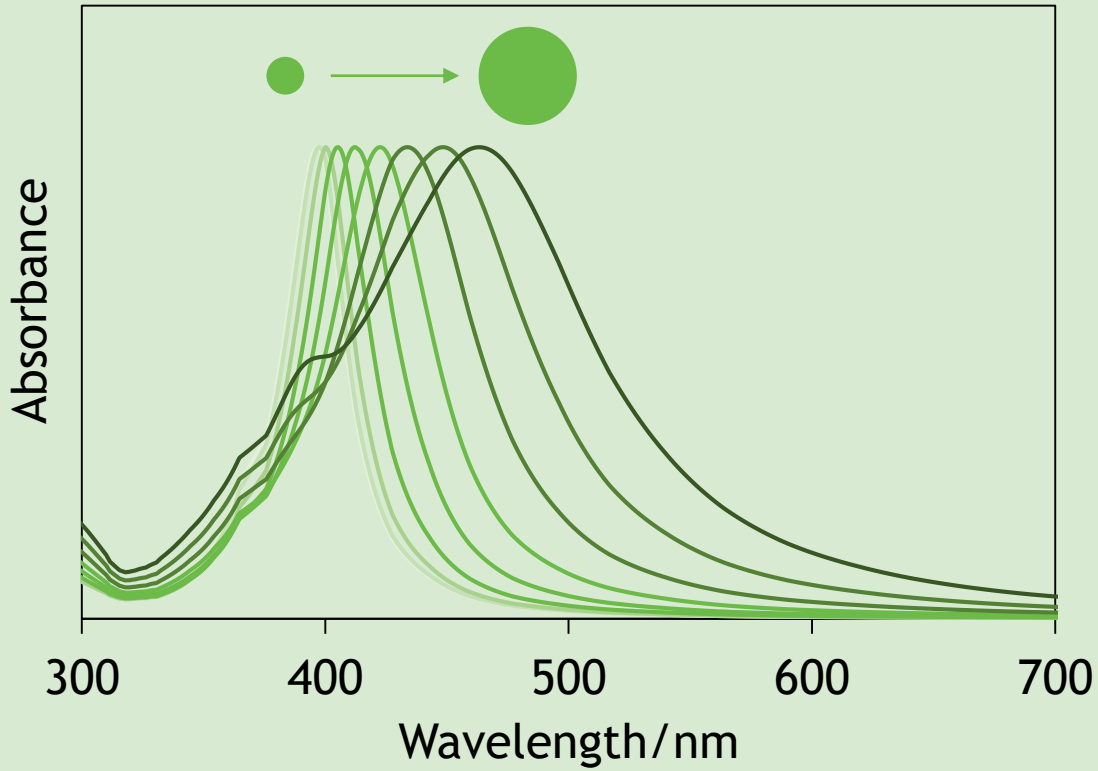




Localized Surface Plasmon Resonance

Silver nanoparticle formation

Characterization: **UV-Visible Spectroscopy**



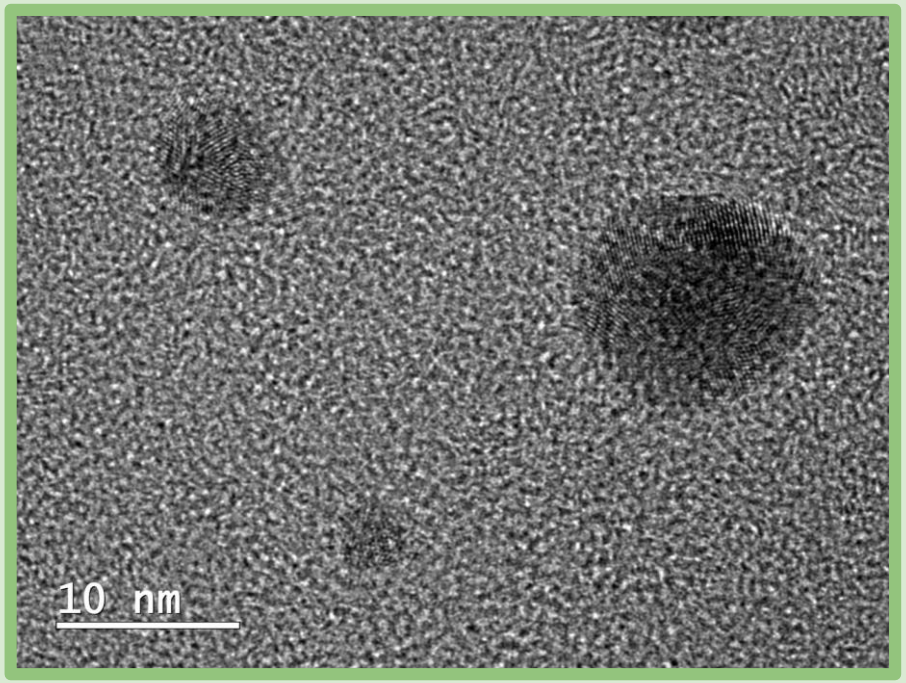
UV-vis peak red-shifts with increasing particle size

Relationship between peak width and particle size distribution

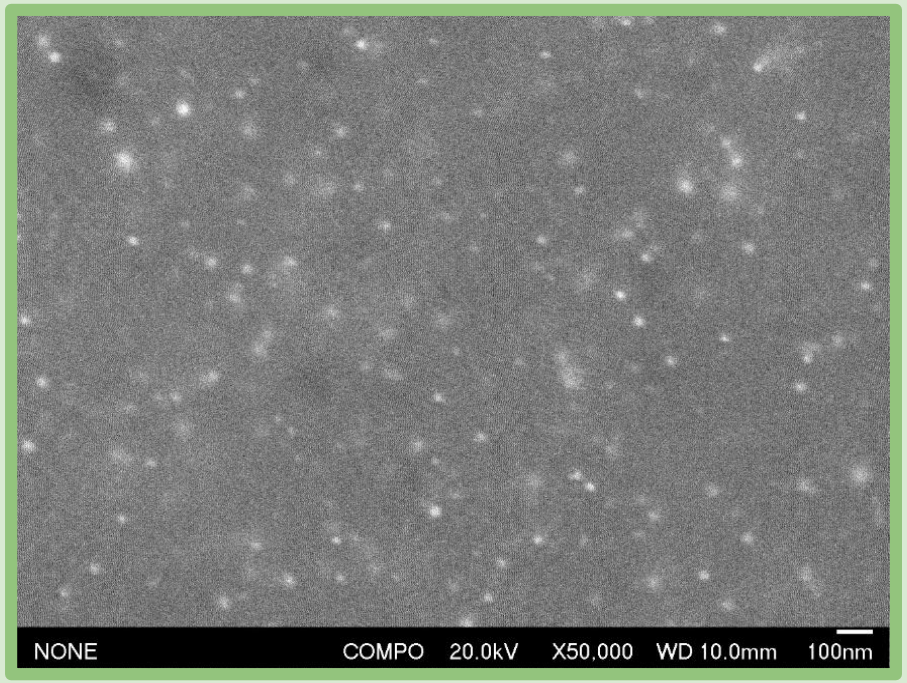
Indication of particle size and distribution

Characterization: **Electron Microscopy**

Transmission Electron Microscopy (TEM)



Scanning Electron Microscopy (SEM)

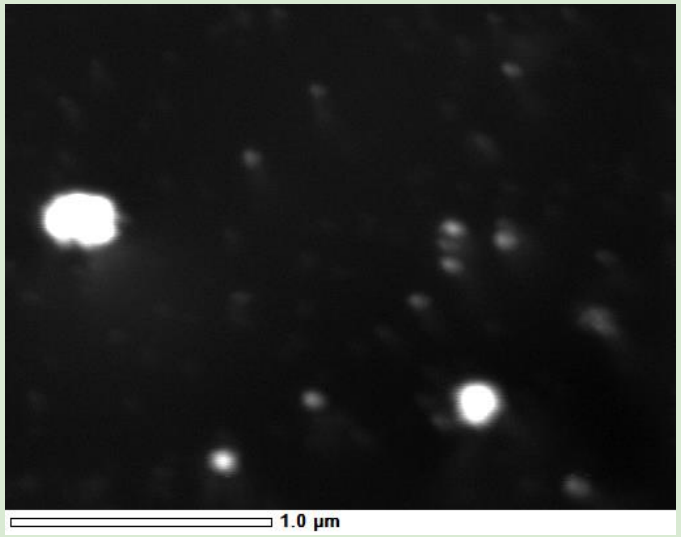


✓ Silver nanoparticle size

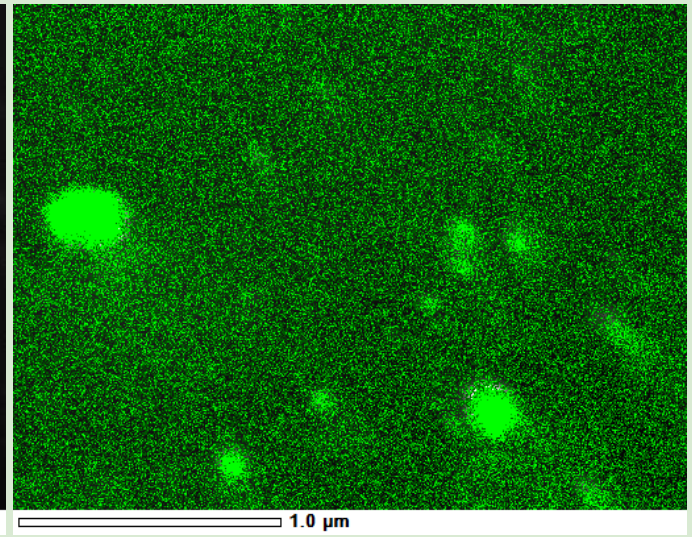
✓ Silver nanoparticle distribution

Characterization: **Electron Microscopy**
Energy Dispersive X-ray Spectroscopy (EDS)

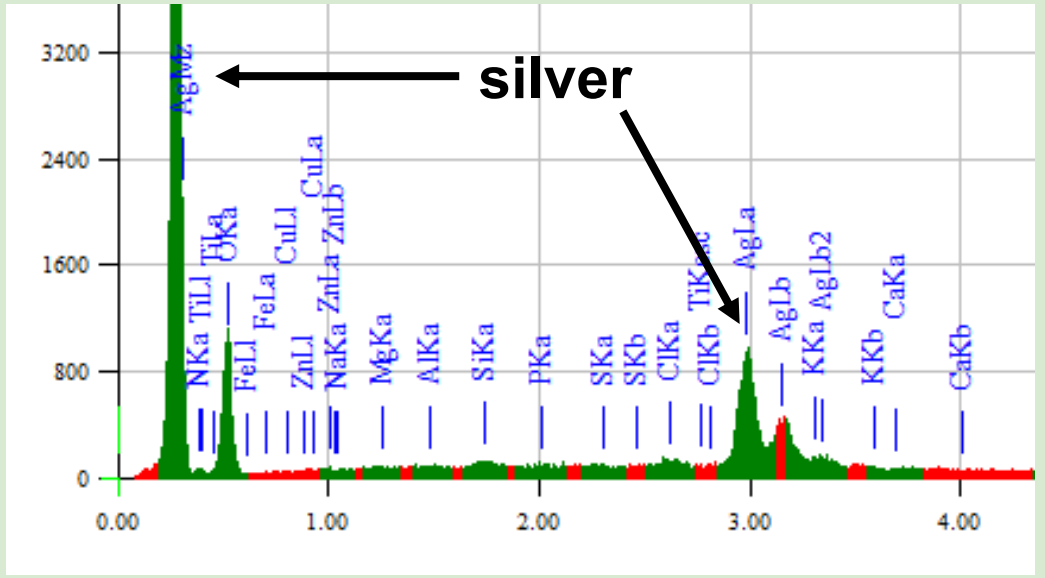
SEM image



Silver map



EDS spectrum



Nanoparticle composition

Characterization: **Silver Leaching Measurement**

In-House Testing

- Coating immersed in water for a set period
- Silver leached into water measured via AA spectroscopy:

< 100 ppb/g silver loss

Independent Testing

- Textile Coating
- *US EPA Method 1311 (TCLP) Method*
- Full immersion & agitation at low pH for 18 hours
- Silver leaching measured via ICP-MS

≤ 0.1% silver loss

✓ Nanoparticles are bound to polymer

Characterization: **Antimicrobial Activity**

JIS Z 2801 Standard

- Quantitative
- Tests the ability of antimicrobial surfaces to inhibit the growth of microorganisms, or kill them
- Industry standard for antimicrobial hard surface performance

Gram-positive bacteria

Gram-negative bacteria

Antibiotic resistant bacteria

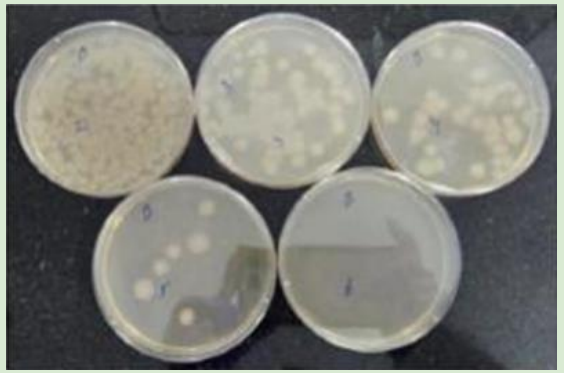
Viruses

Fungi & mold

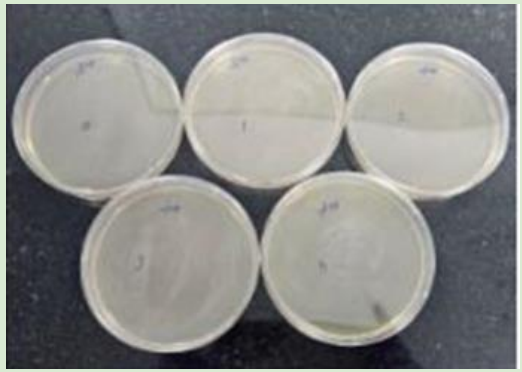
Characterization: **Antimicrobial Activity**

Antibiotic-resistant bacteria: **MRSA**	Architectural paint for hospitals	JIS Z 2801	**> 99.9% reduction**

Bacteria: ***E. coli***	Textile application	AATCC 100	**99.999% reduction**



Control

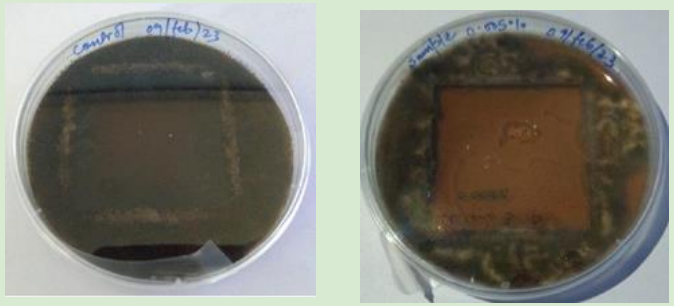


Treated textile

Virus: **human coronavirus**	Coating	JIS Z 2801	**99.86% reduction**

Independently tested by Microchem & MIS

Characterization: **Antimicrobial Activity**

Fungi: ***Aspergillus niger***	ASTM G21	**No growth observed**	 *Control* *Treated*

Fungi: ***Candida auris***	JIS Z 2801	**> 99.9% reduction**

Independently tested by MIS

Characterization: **Other**

Depending on the application, other characterization can include:

- XRD, FTIR
- Toxicology
- ISO 90993 Testing: Cytotoxicity, Hemocompatibility
- Physical Testing

How it works:

Paint, coating, or other polymer-based system

Apply antimicrobial technology

Characterization & optimization

Base resin used in coating

- Unformulated -

Functionalized, silver-resin composite

High concentration of active ingredient: can be used as an additive

Concentration & Color

Photographs of silver-resin composite applied to textile:

100% **Decreasing concentration** 0% (control)

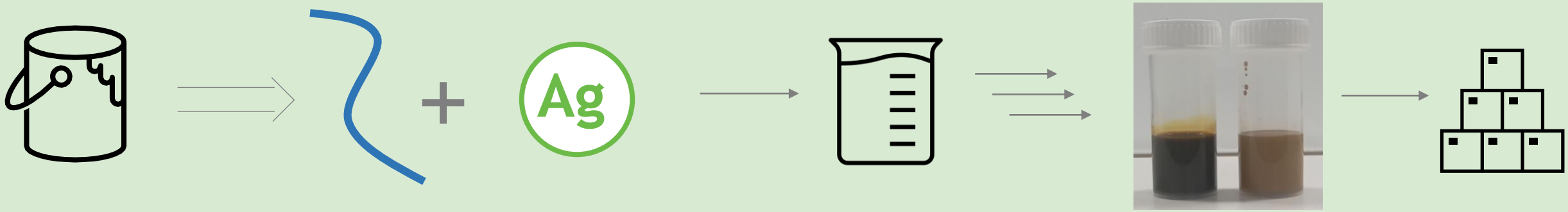
← > 99.9% microbial reduction across all concentrations →

How it works:

Paint, coating, or other polymer-based system

Apply antimicrobial technology

Characterization & optimization



Base resin used in coating

- Unformulated -

Functionalized, silver-resin composite

Scale up

Scale-Up

- From small lab samples to gallon-sized batches for feasibility testing
- In-house capability: 25 kg pilot-scale batch size
- Ability to scale further with partner support

Summary: Bespoke Antimicrobial Coatings

Customized solution - using your resin system

Range of different polymer types

Tech is non-leaching, highly effective, & safe

Advantages over ready-to-go additive solutions

Inhibit Coatings

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