TechCon 2022 Long Beach

Antimicrobial Transparent Protection for Touch Screen Application

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Outline of Presentation

- Introduction to Gencoa
- The need for Antimicrobial Protection and Self-Sanitising Screens
- Gencoa's iCnano Technology
- Development of Material and Deposition
- Real World Application
- Gencoa Miller Antimicrobial Results
- Standard Antibacterial Results from University of Liverpool
- Summary and Conclusions

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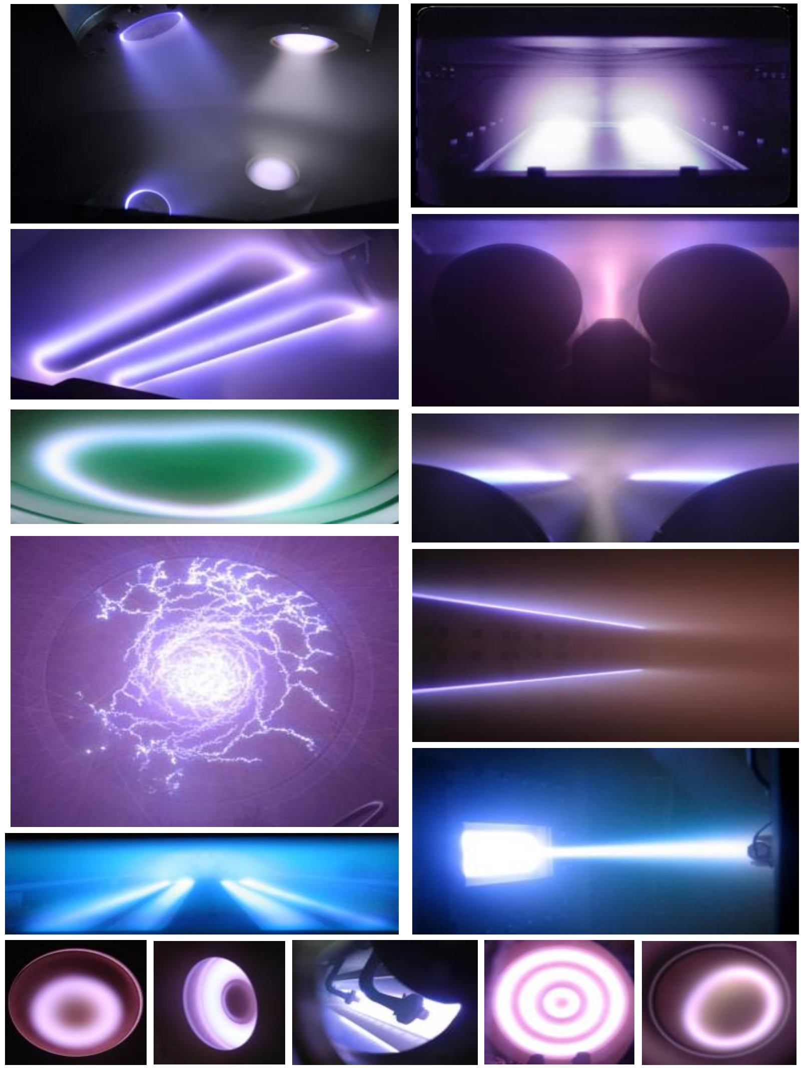
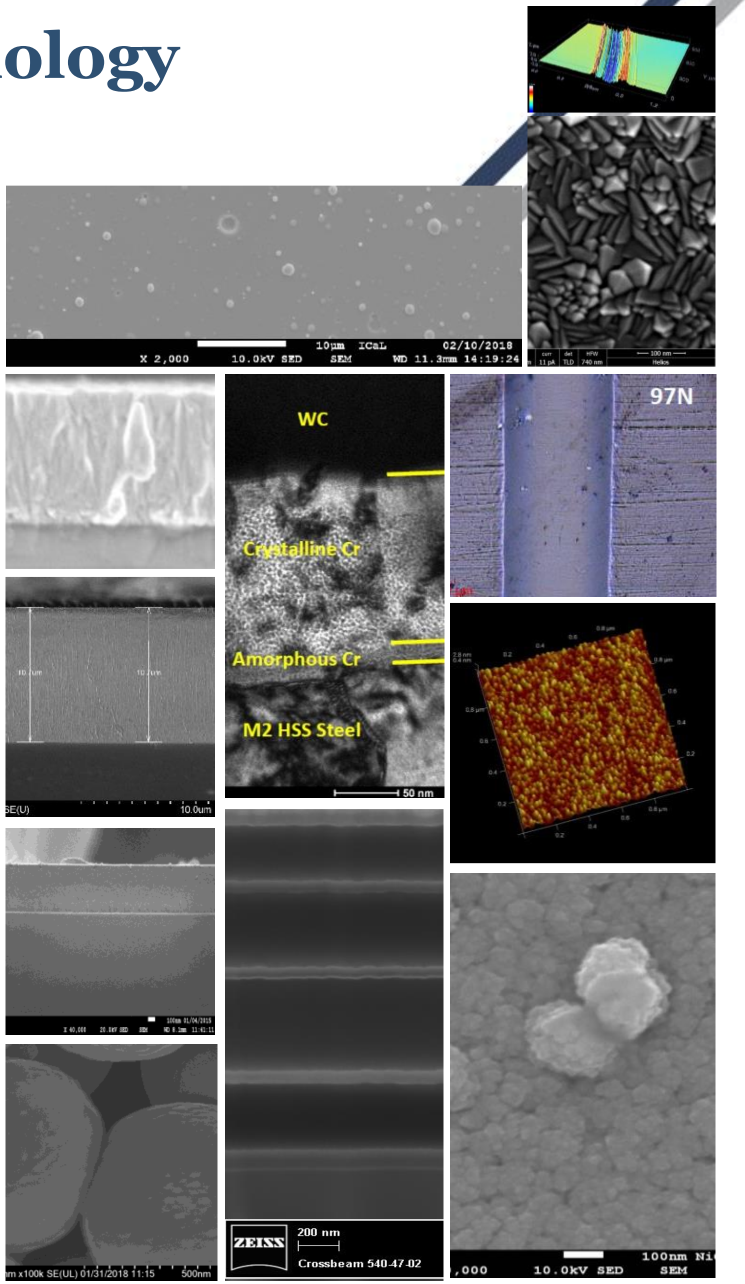
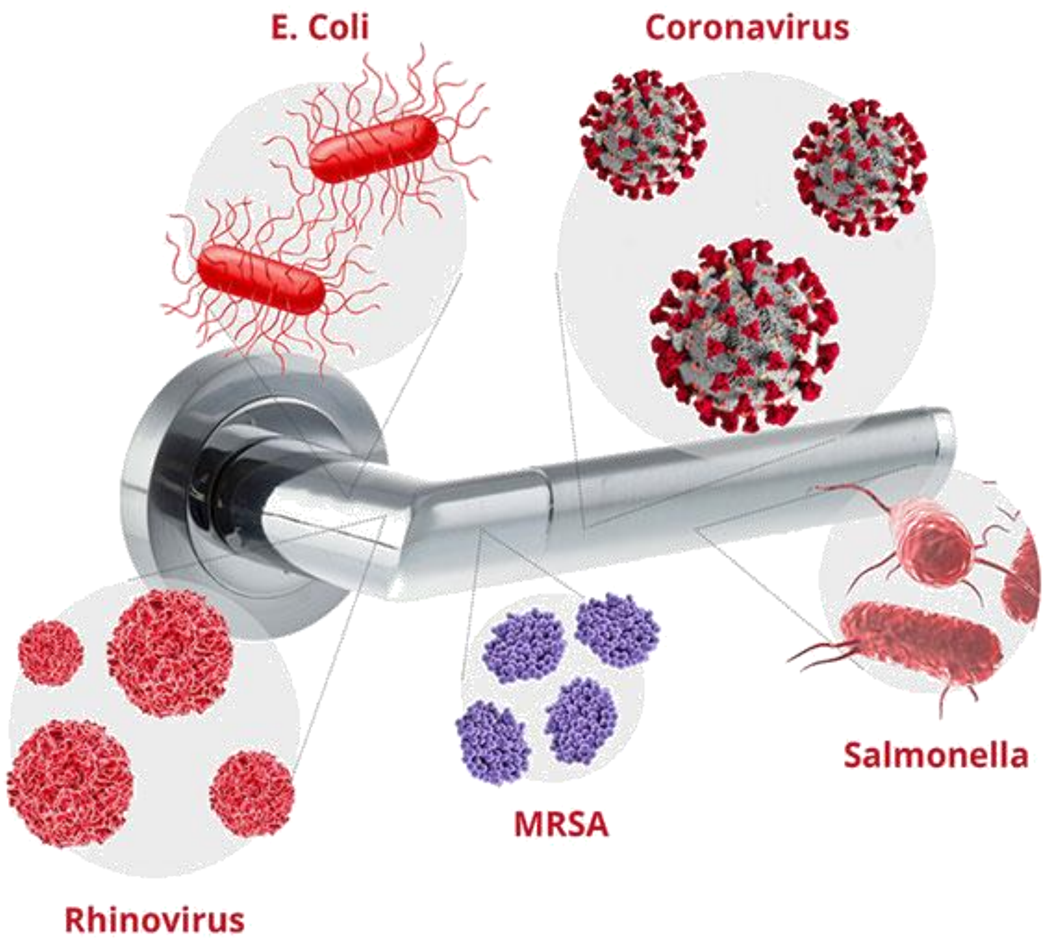
27 Years of Products and Technology from Gencoa





The Need For Antimicrobial Protection

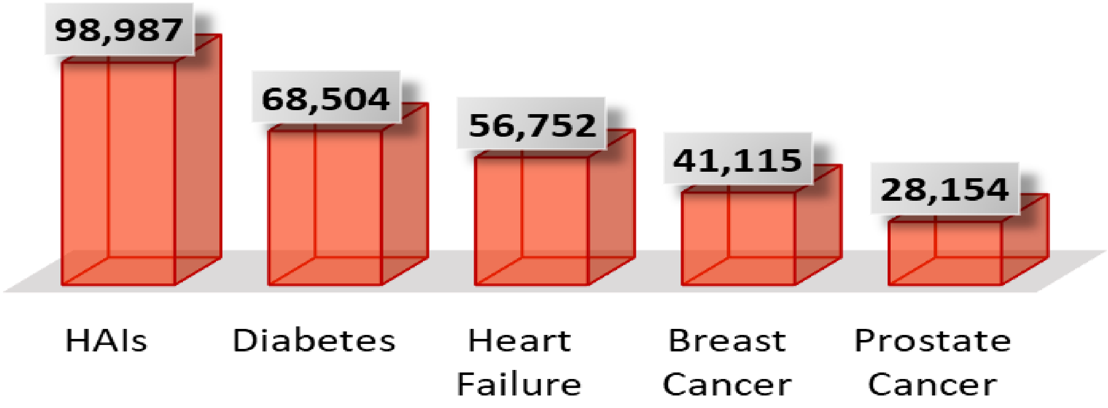
Need for protection on 3D & 2D objects



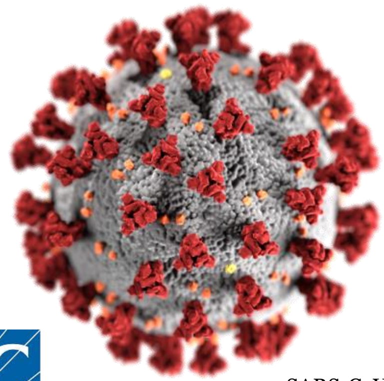
The Need For Antimicrobial Protection

The CDC estimates that 80% of infectious diseases are transferred by touch

In the US ~100,000 people die annually due to Hospital Associated Infections, many of which are contracted through touch



HAIs kill more people each year than Breast Cancer and Heart Failure combined

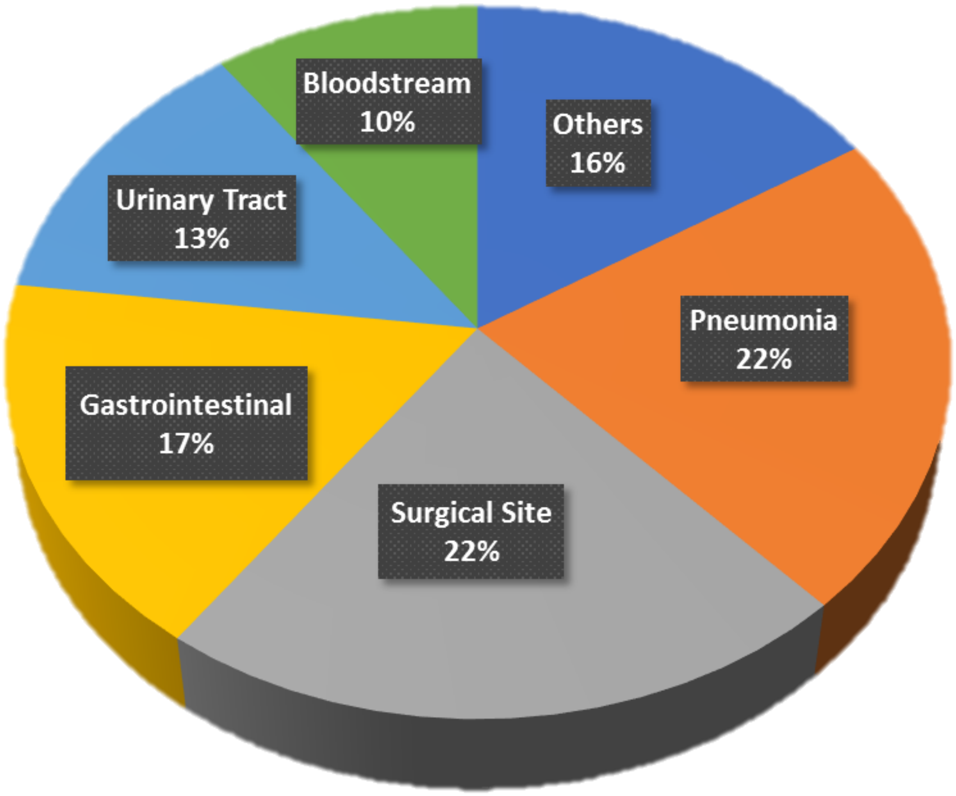


SARS-CoV-2
Image Source
CDC

HAIs Infections: in US

CDC reported the most common germs causing HAIs were;

- C. difficile (12%);
- Staphylococcus aureus, including MRSA (11%);
- Klebsiella (10%);
- E. coli (9%);
- Enterococcus (9%);
- Pseudomonas (7%).



The Need for Self-Sanitising Screens

- Touch screen devices are common place among a vast number of sectors
- Upwards of **10,000** people can use a single ticketing kiosk everyday in a busy station in the UK alone
- There is an urgent need to implement smart self-sanitising technology

The Need for Self-Sanitising Screens

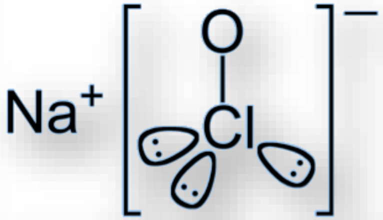
- ❑ Retail
- ❑ Food Industry
- ❑ Entertainment
- ❑ Hospitality
- ❑ Transport

Environmental Effect

•**Water Pollution** – Thousands of chemicals from cleaning products are washed into streams and rivers

•**Air Pollution** – Volatile organic compounds (*VOC*) in cleaning products can affect indoor air quality and add to outdoor smog

•**Waste** – Many containers are not made from recyclable materials. Packaging and empty plastic bottles often end up in landfills



Sodium Hypochlorite Chemical Structure

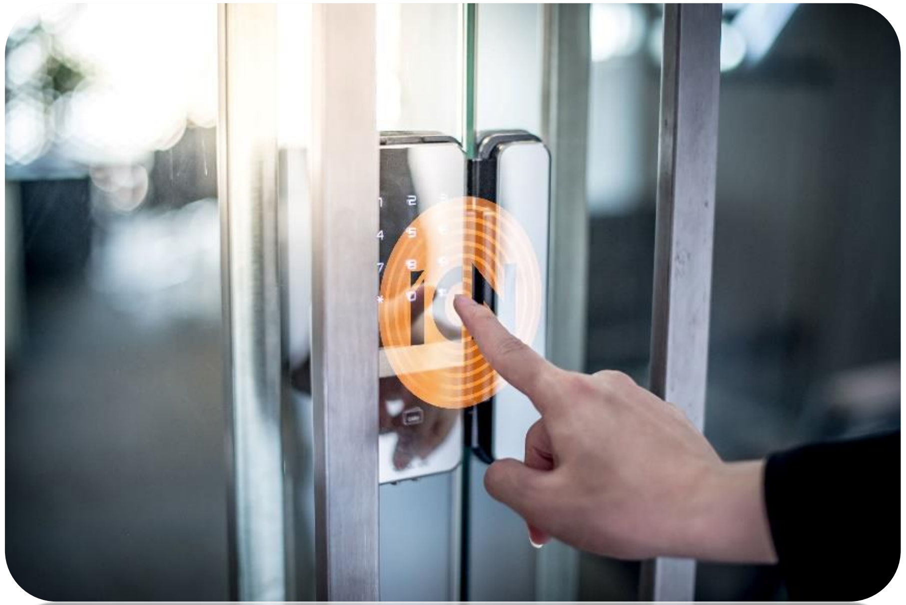
www.pjponline.com

Gencoa's iC-nano Protection

Infection control via nanotechnology

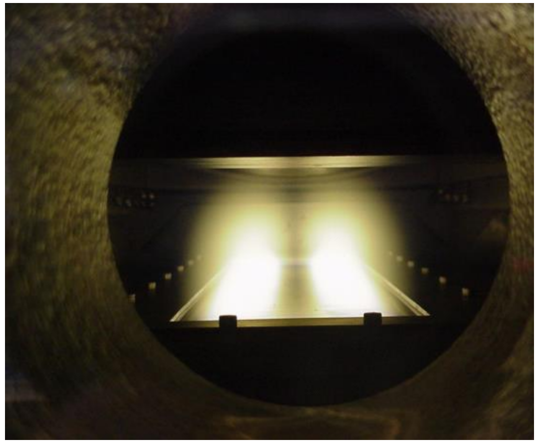
Gencoa has patented nano-structured coatings for antimicrobial and antiviral applications.

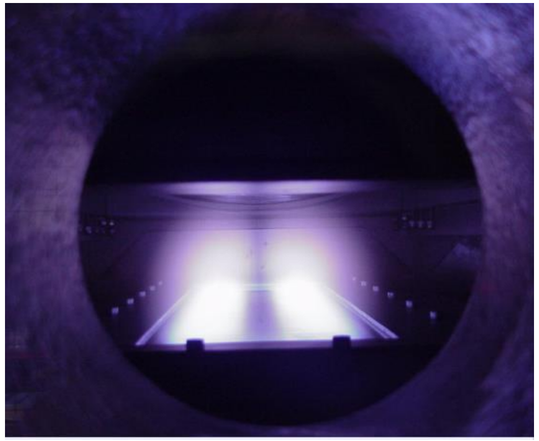
The layers are opaque, transparent or semi-transparent with varying hardness levels and with killing efficiencies of 99.9999% under standard testing conditions.



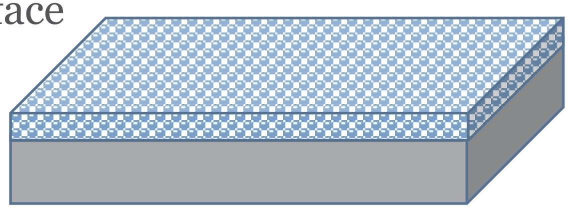
Why Sputtering is an ideal choice

- ❑ Controlled features – Smooth/Rough
- ❑ Coating chemistry variations
- ❑ Added functionality
- ❑ Cheaper alternative to monolithic materials when it comes to combating bacteria and viruses on touch surfaces.



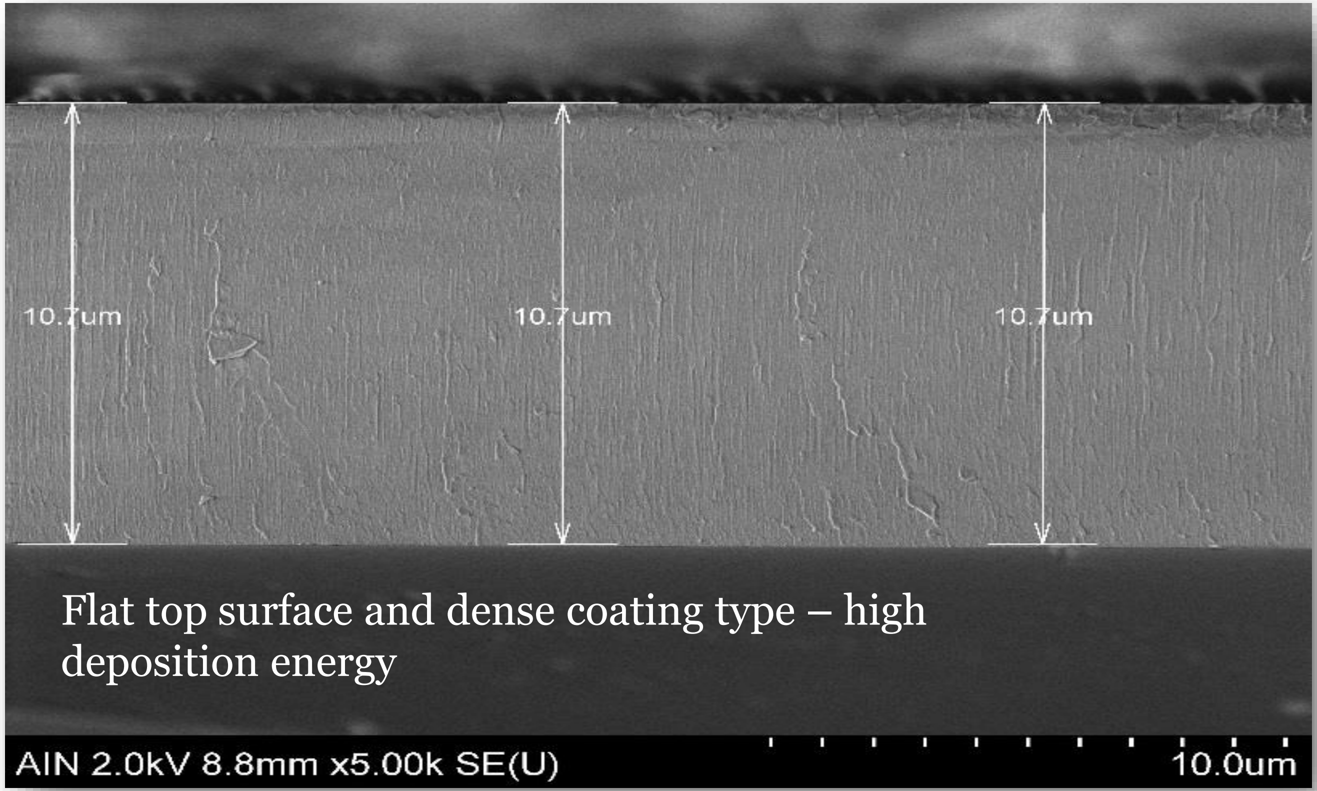


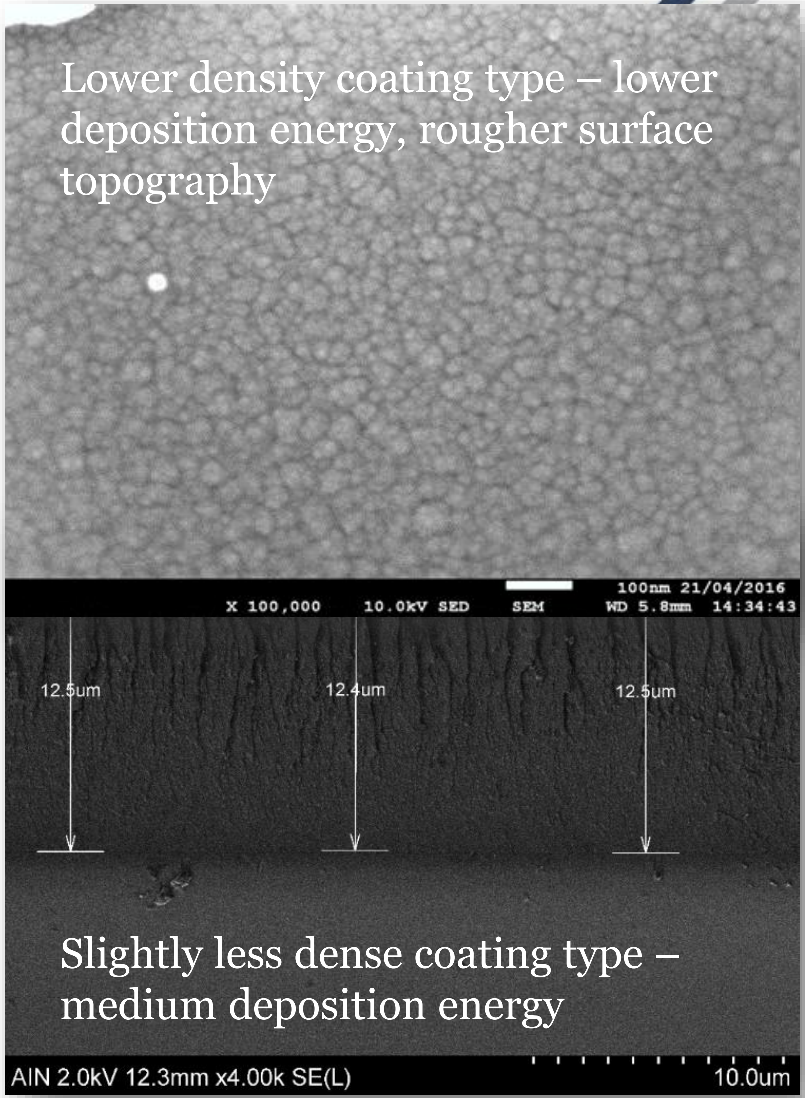
Biocidal material is in full concentration on the surface



Sputtering – Deposition Energy

For the antimicrobial layers, less energy and less smooth layers are desired – rougher top surface

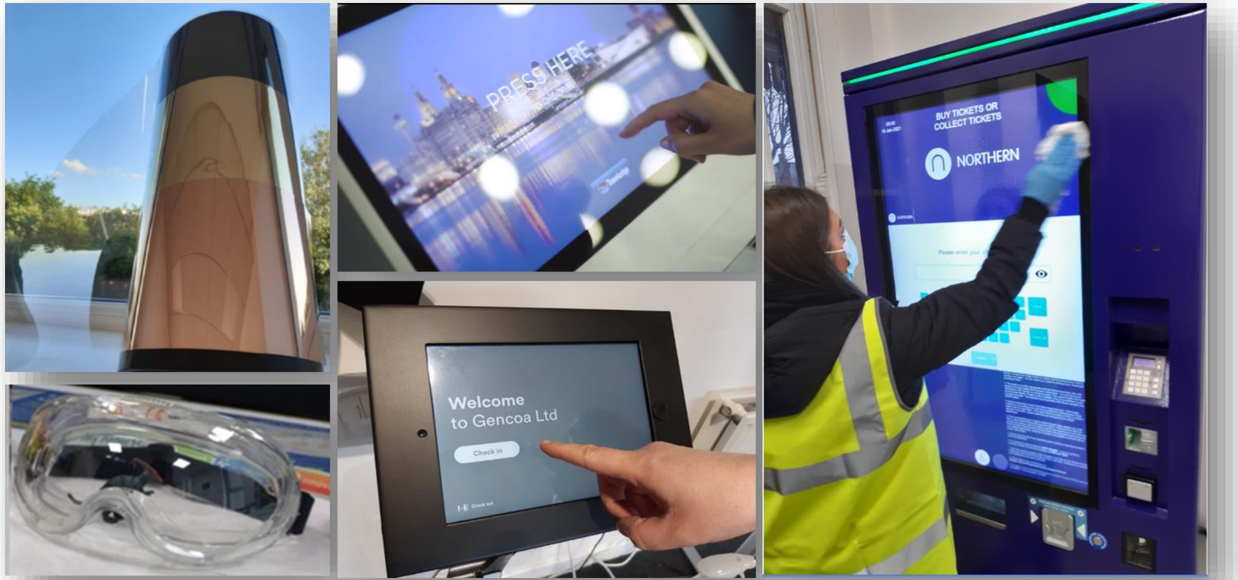




Developing the Material

- Different levels of transparency depending on thickness < 40nm

- Ability to maintain transparency and high level biocidal activity

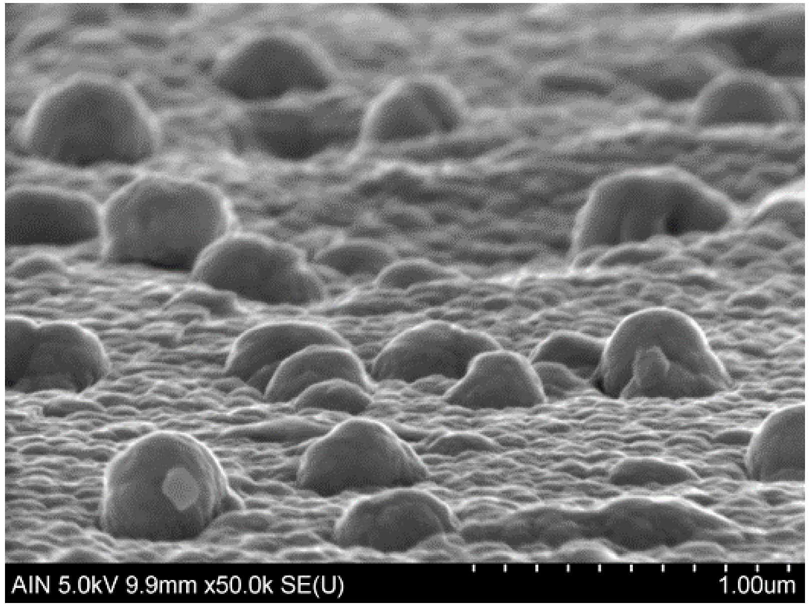


What makes a surface antimicrobial / antiviral?

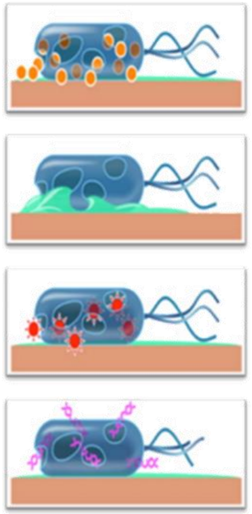
Electrochemical reaction

$$\boxed{BACTERIA + O_2 \xrightarrow{M^{n+}} CO_2}$$

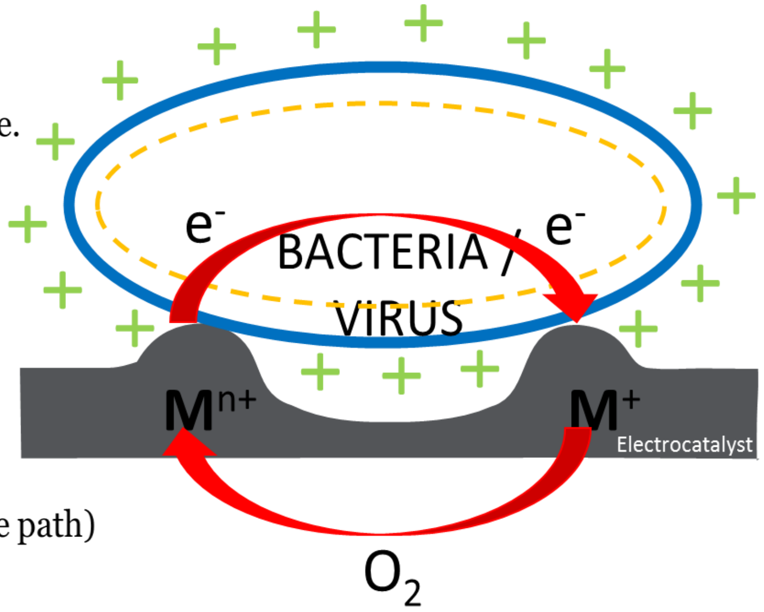
The electrocatalyst helps to "oxidize" the microbe or viral material.



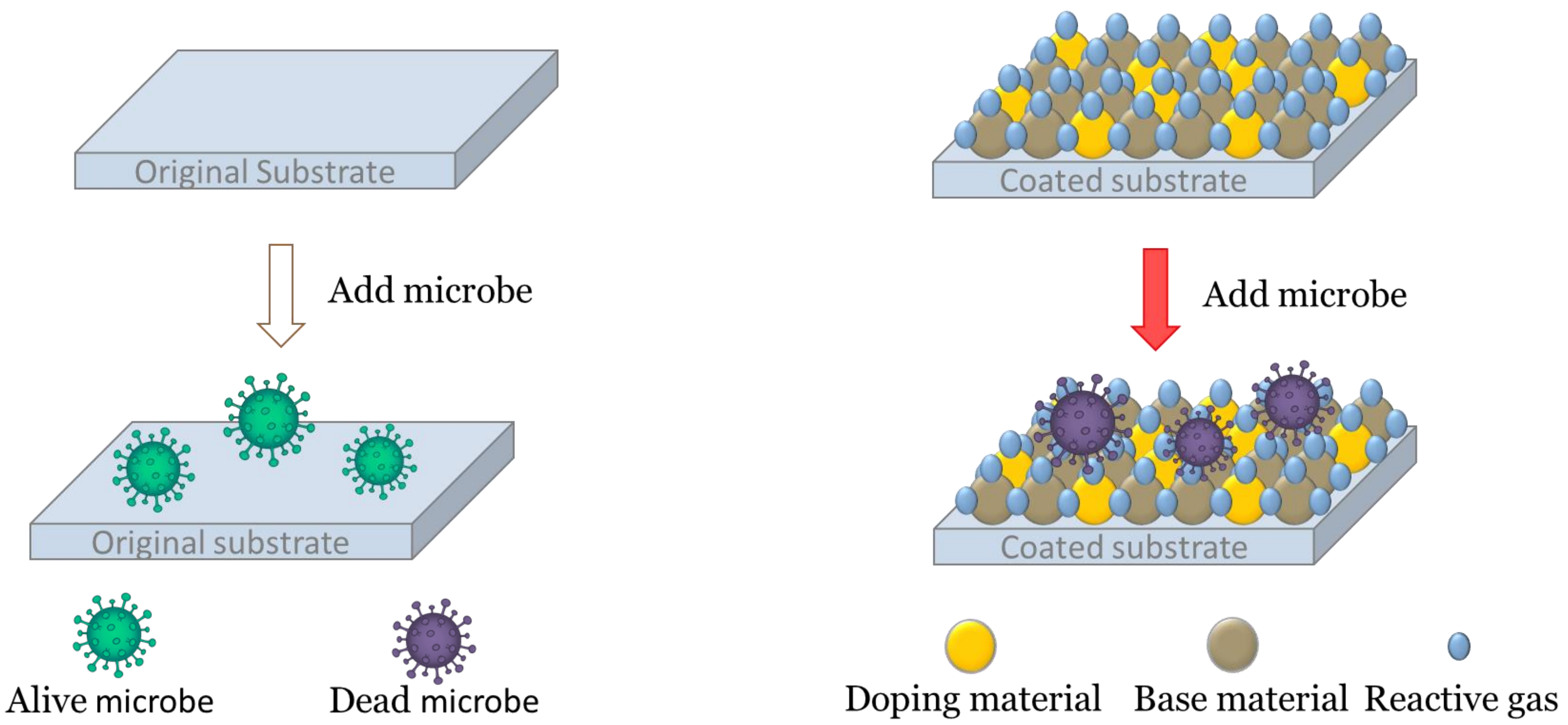
Mode of action



- Material dissolves and causes cell damage.
- Cell membrane ruptures.
- Oxidative stress (further cell damage)
- Bacterial DNA degradation (no resistance path)



Coating Principle



Deposition Set-up

Step 1

High Vacuum
Background ~·10^{-6} mbar

Step 2

Substrate cleaning
Ion Source **IM300**
Used for coating adhesion

Step 3

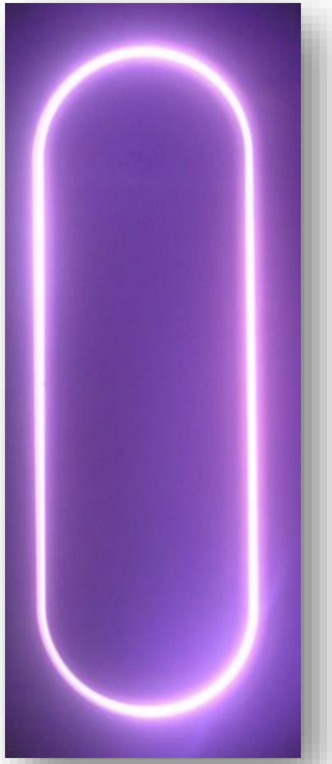
Active Coating
Gencoa Magnetron
Process Gas
Reactive Gas

Step 4

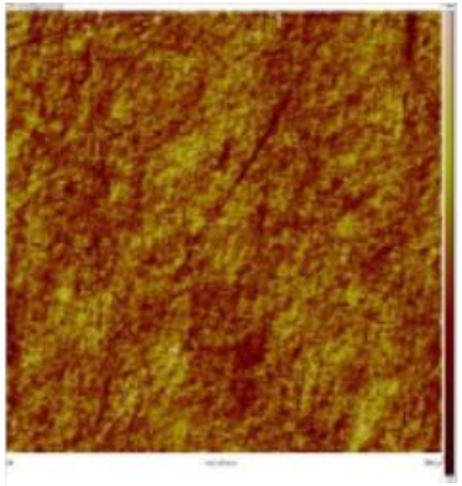
Feedback Control
OPTIX
Speedflo
Fibre Optic

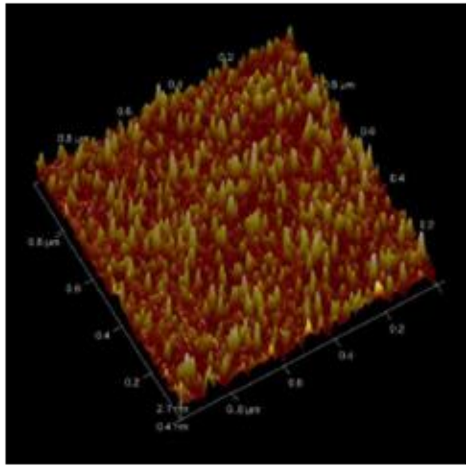
Substrate Cleaning

- Improves adhesion of the antimicrobial coating
- Removes organics from substrate surface
- Has the means to liberate moisture and burn-off hydrocarbons before the sputtering process



Importance of Pre-treatment and surface preparation





Control Options by Gencoa

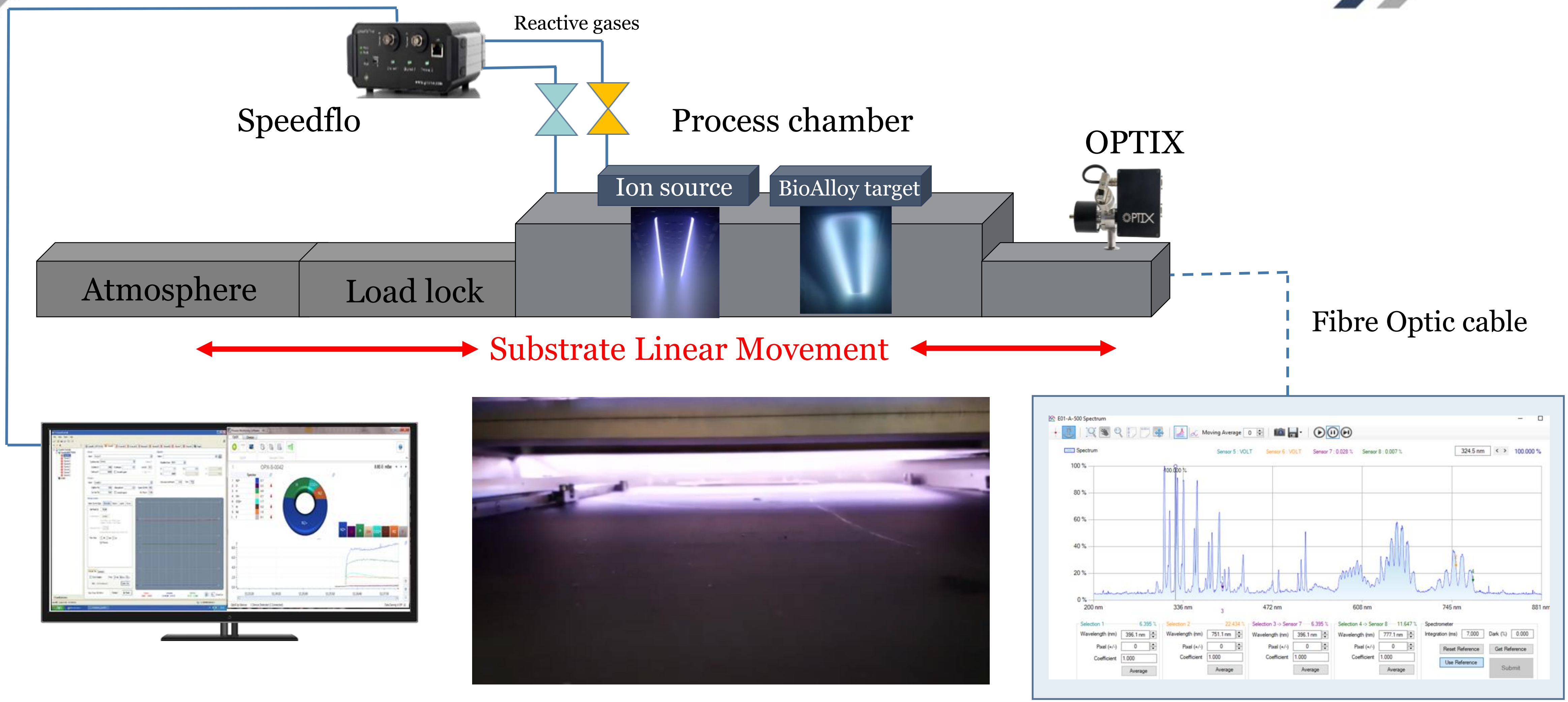
Feedback control units were used on the system to ensure good control and reproducibility

Gas sensing device used for monitoring vacuum quality and fast process feedback and flow control.

Speedflo mini

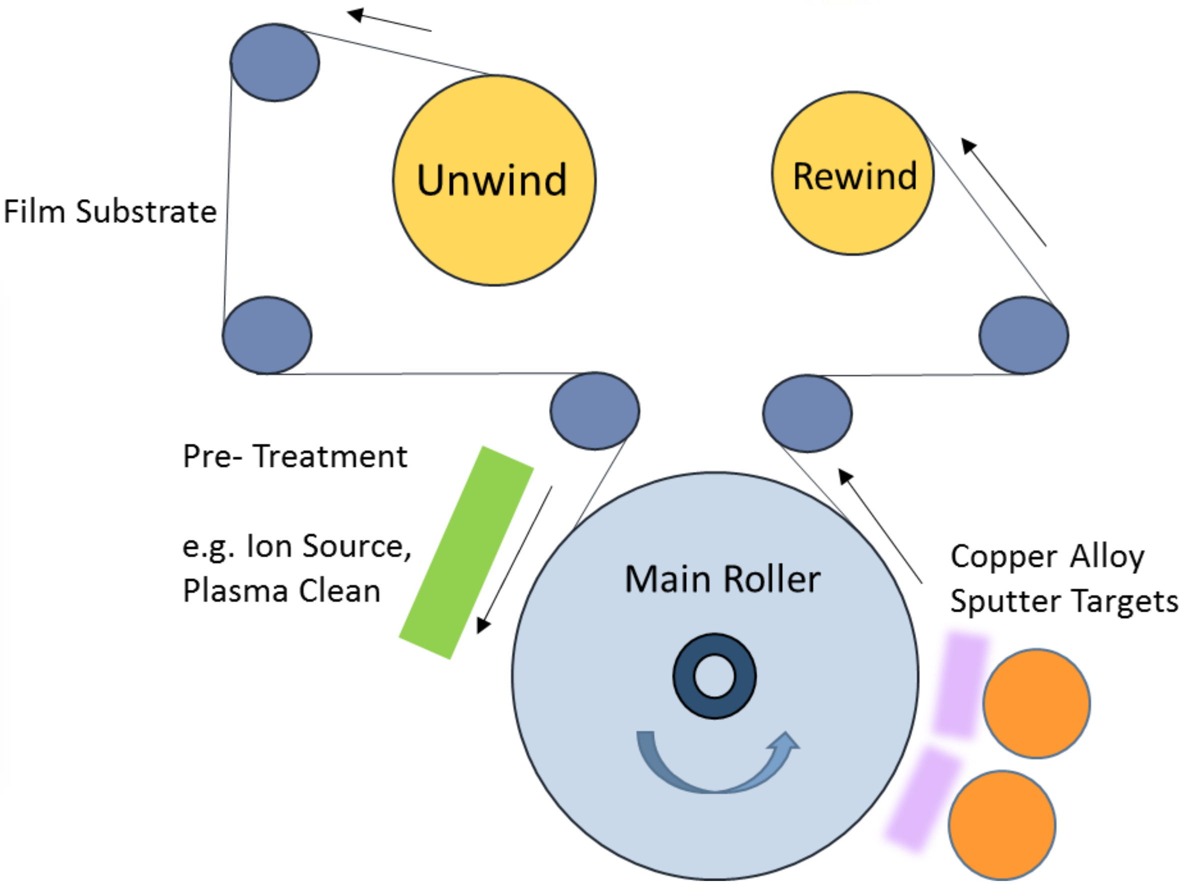
The controller has 3 fully featured and independent control channels allowing for simultaneous feedback control of up to 3 MFCs.

Deposition Process



Deposition Process

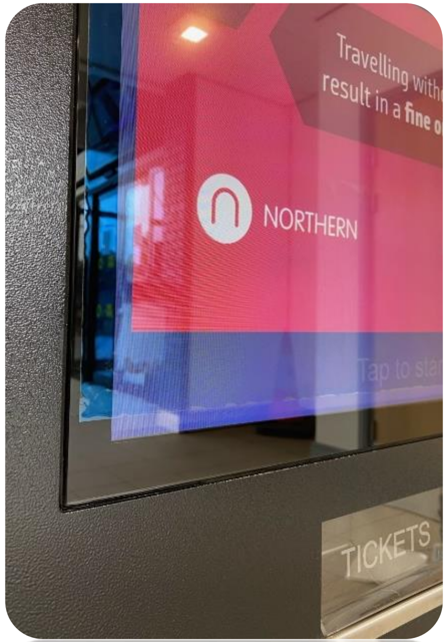
The coating technology has the capability to be scaled up to Roll-to-Roll process resulting in a larger volume throughput for commercial use.



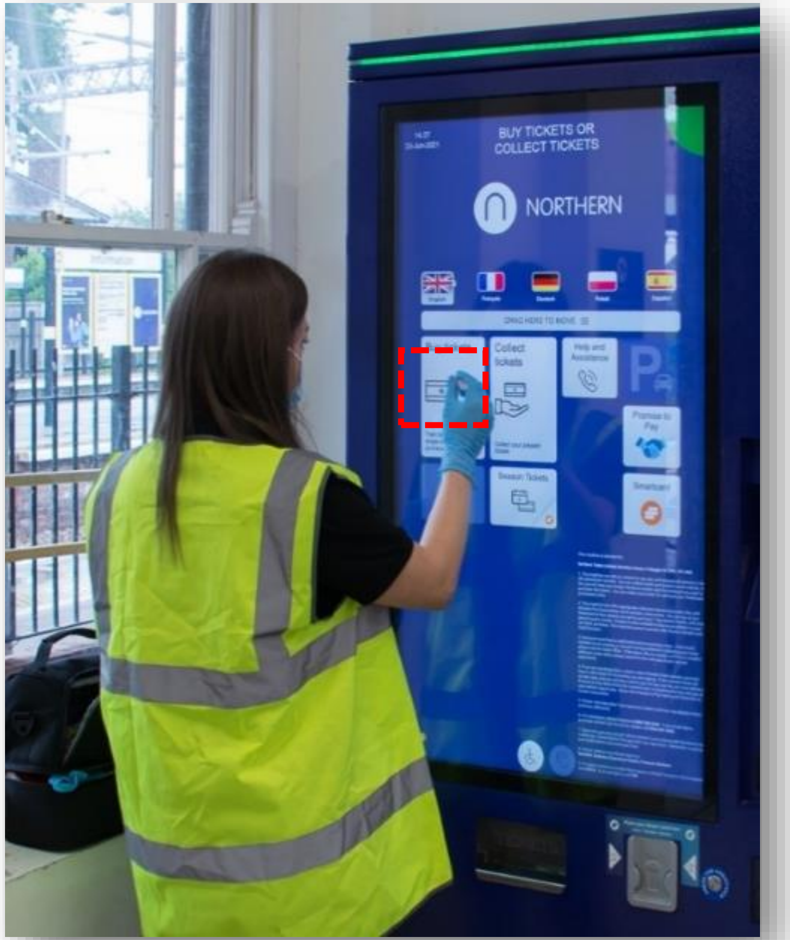
Real World Application

Large polymer films with Gencoa's iC-nano antimicrobial coating were installed on train ticketing kiosks around the North West of England.

The protective films were tested in-situ over a period of **3 months**.

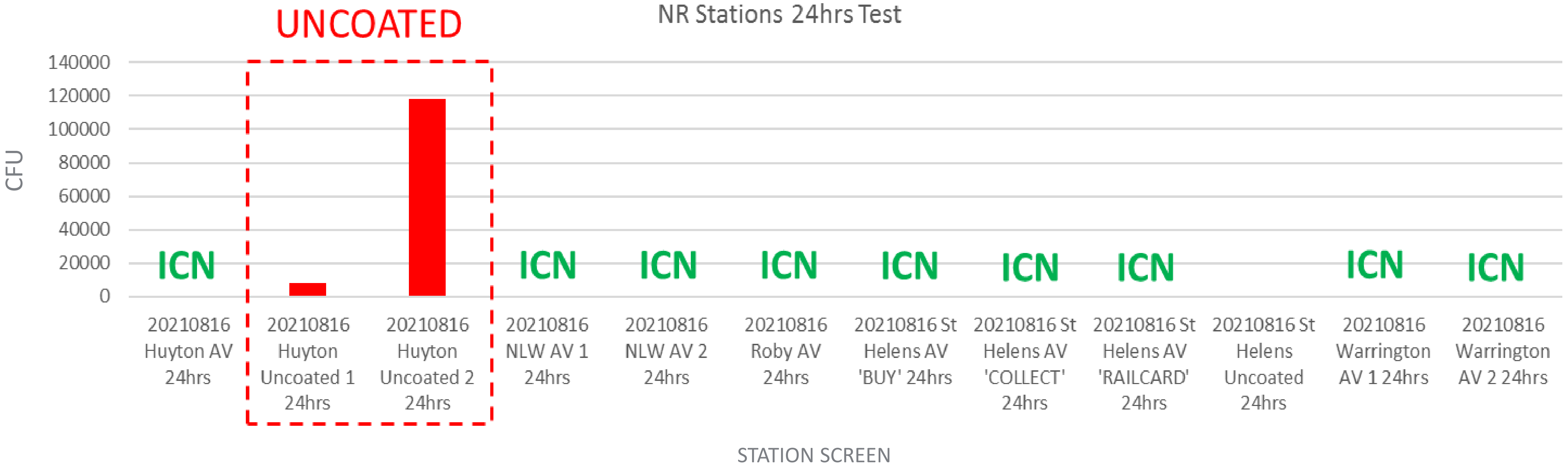


Bio-fouling Assessment

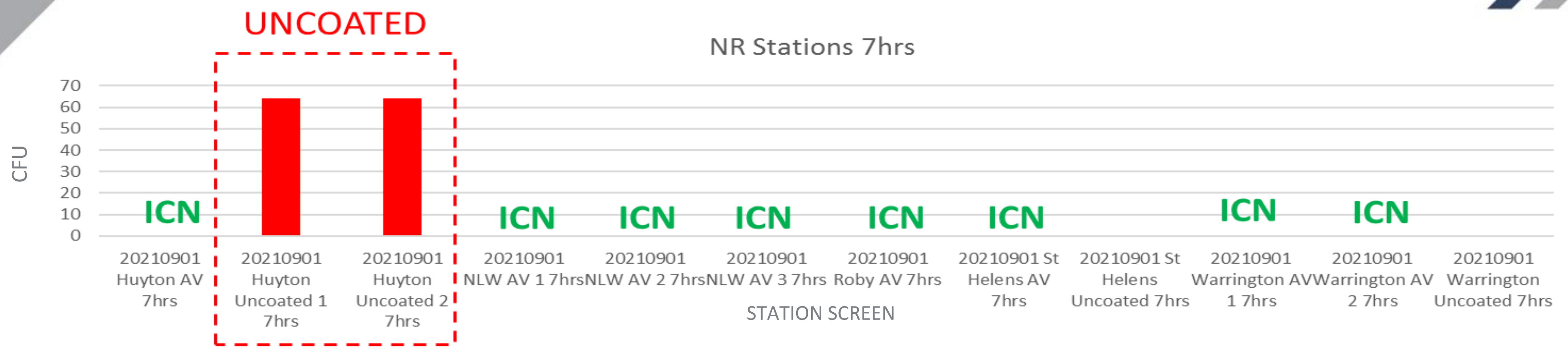


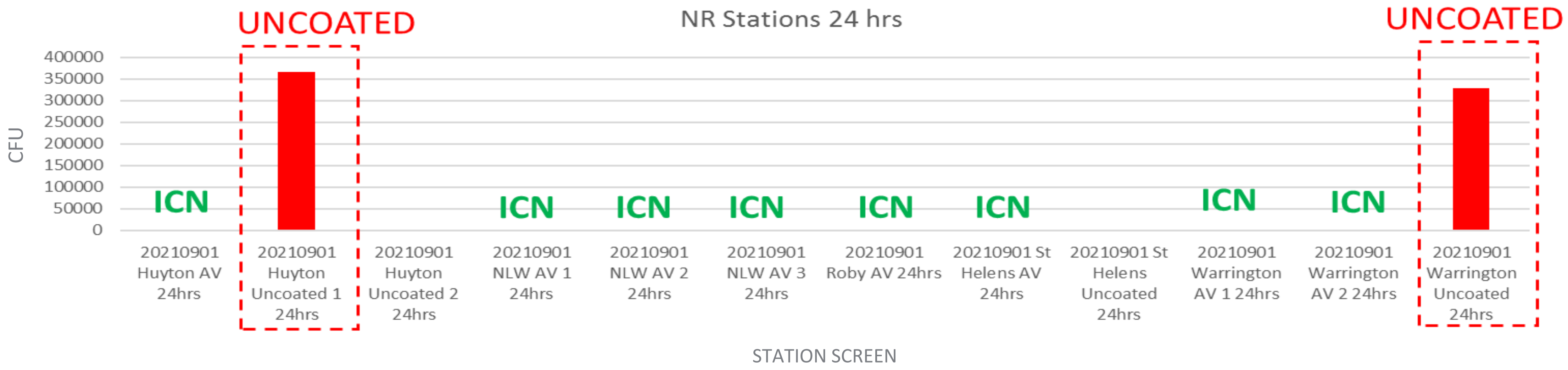
Sampled by swabbing, grown in media and bacteria counted

CFU Assessment

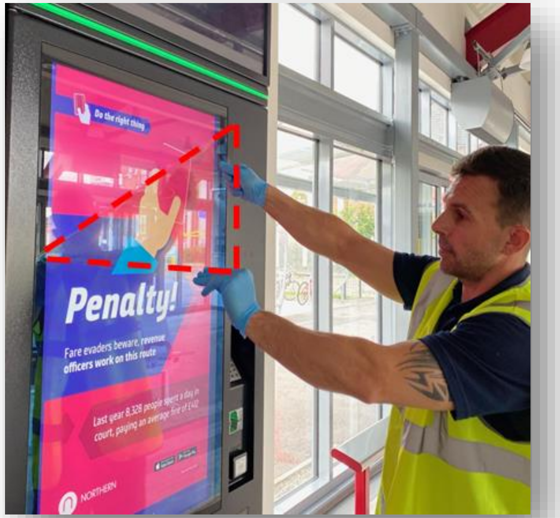


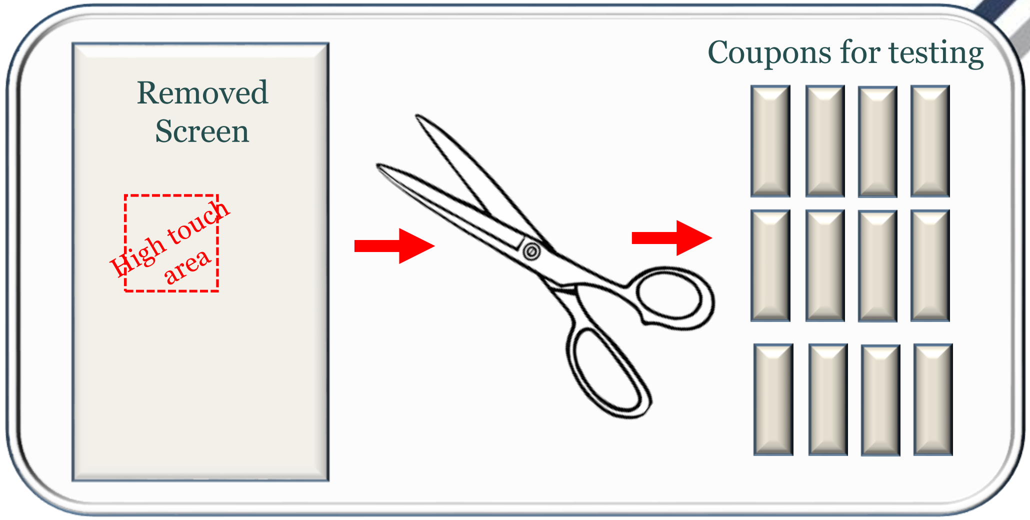
CFU Assessment





Removed Screens and Testing

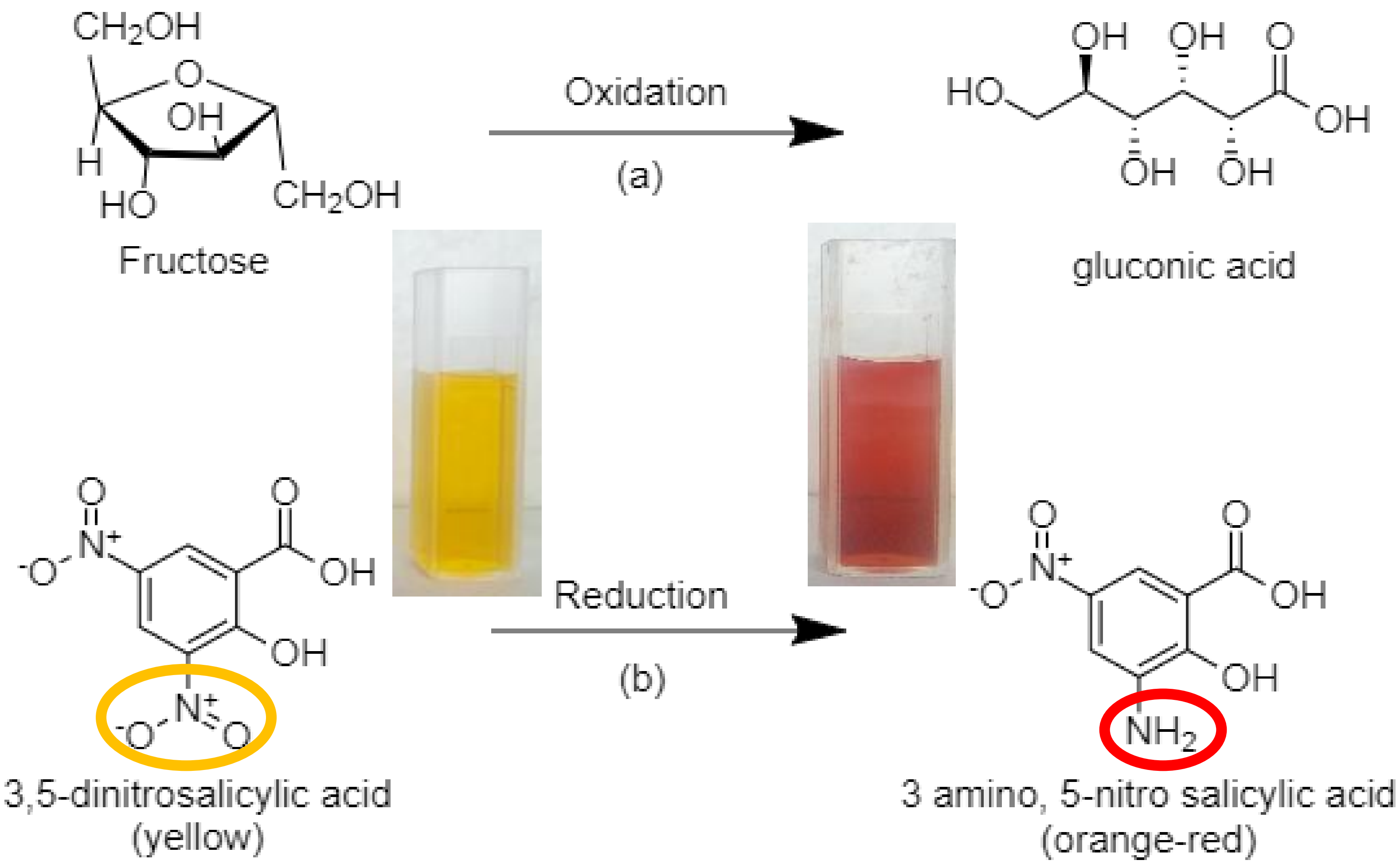




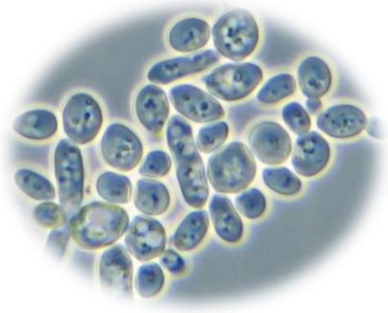
Newton-le-Willows   Warrington West   St Helens   Huyton   Roby

Miller Redox Principle

G. L. Miller; Anal. Chem., 1959, 31 (3), pp 426–428



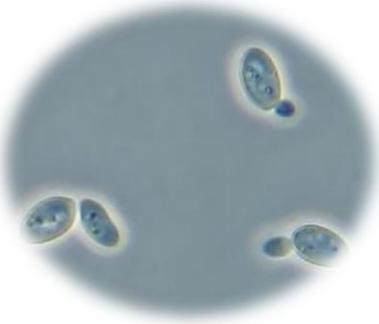
Antimicrobial Level Assessment
Gencoa-Miller



NO ANTIMICROBIAL

More microorganisms – Less Fructose

R-NO_2



ANTIMICROBIAL

Less microorganisms – More Fructose

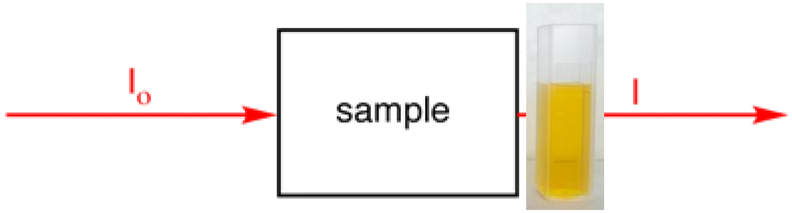
R-NH_2

Antimicrobial Performance Testing

CCD Spectrophotometry (Absorbance)

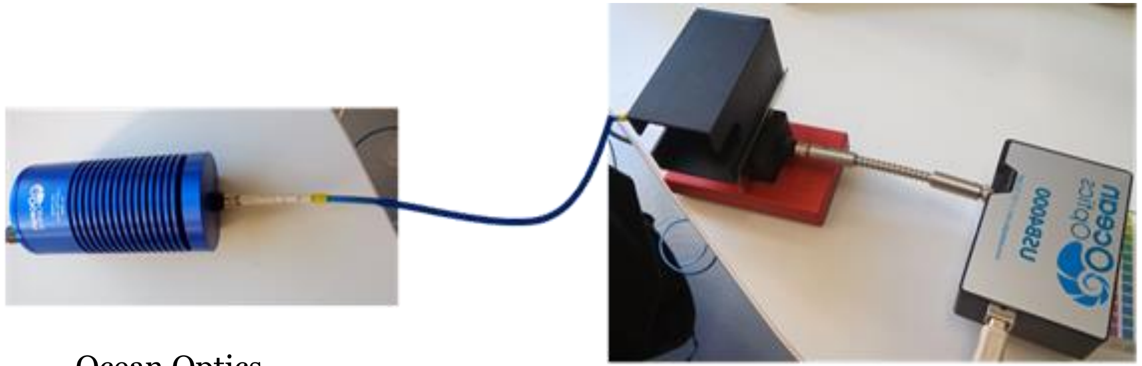
The spectroscopic methods would allow a higher precision on the concentration of fructose.

$$A = \log\left(\frac{I_o}{I}\right)$$



I_o = intensity of the light entering the sample

I = intensity of the light leaving the sample



Ocean Optics
(Halogen Lightsource HL-2000)

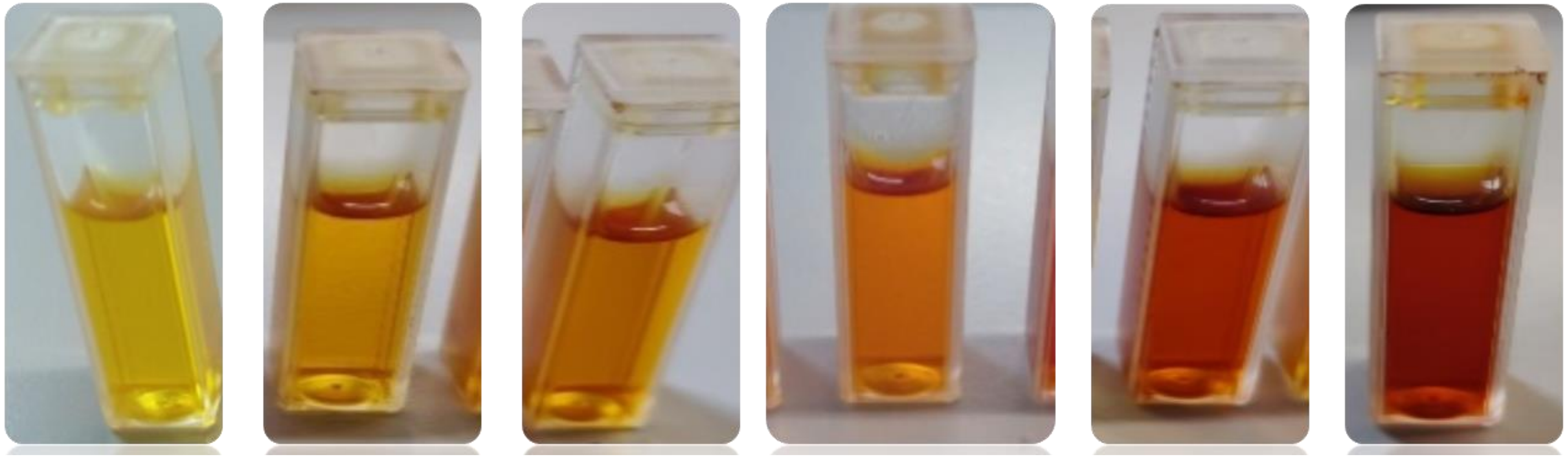
Ocean Optics USB4000 spectrophotometer
+ AVANTES cuvette holder

The **absorbance** measured using a UV-Vis spectrophotometer is **<u>directly proportional</u>** to the amount of **reducing sugar.** (Adney and Baker, 1996)

Antimicrobial Performance Testing

Coating Development Phase

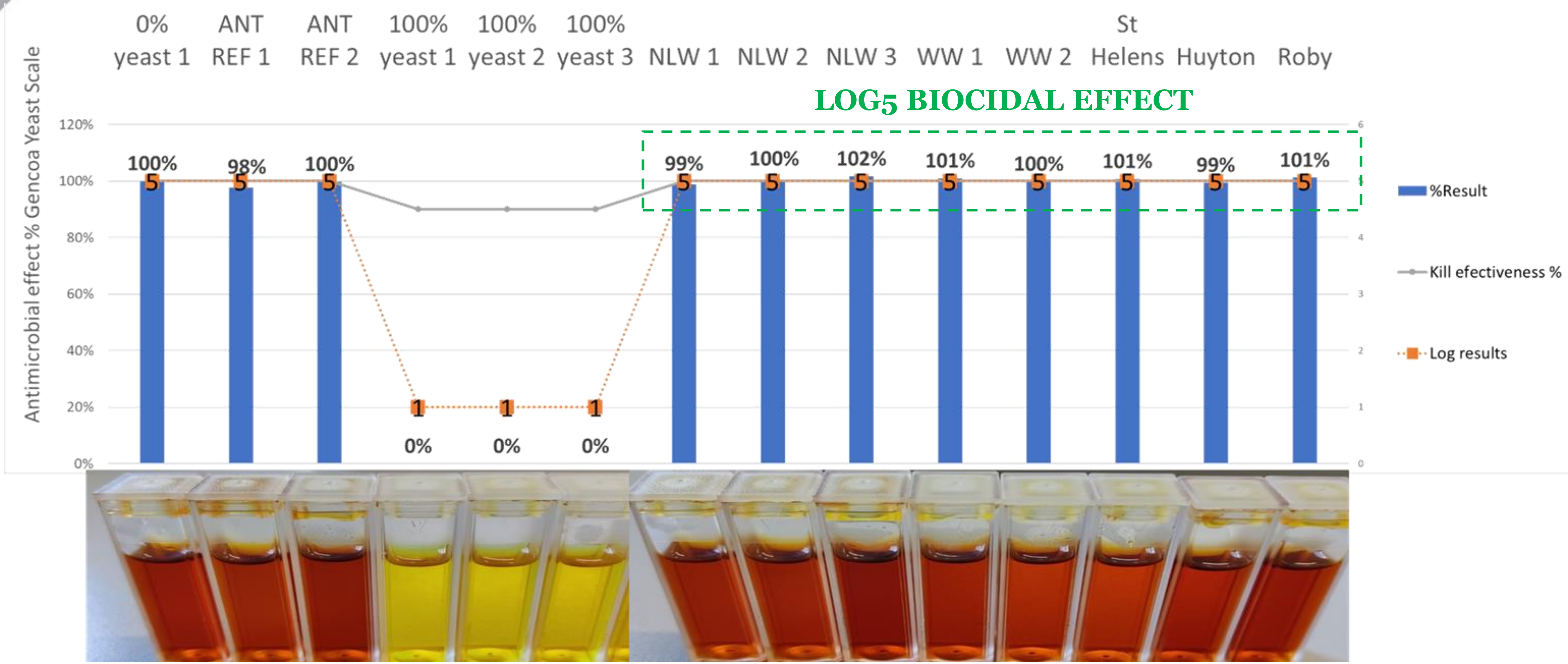
0% 22% 41% 60% 97% 100%



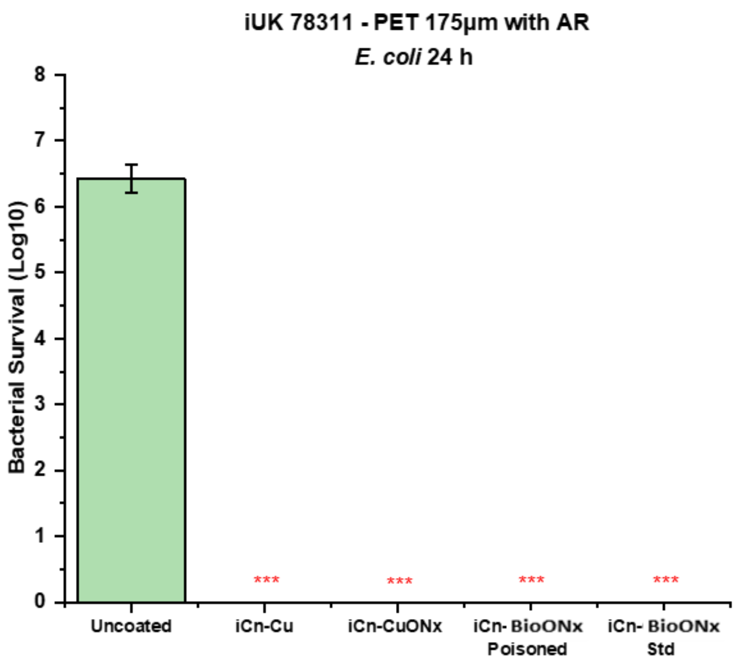
100% represents greater than LOG5 reduction

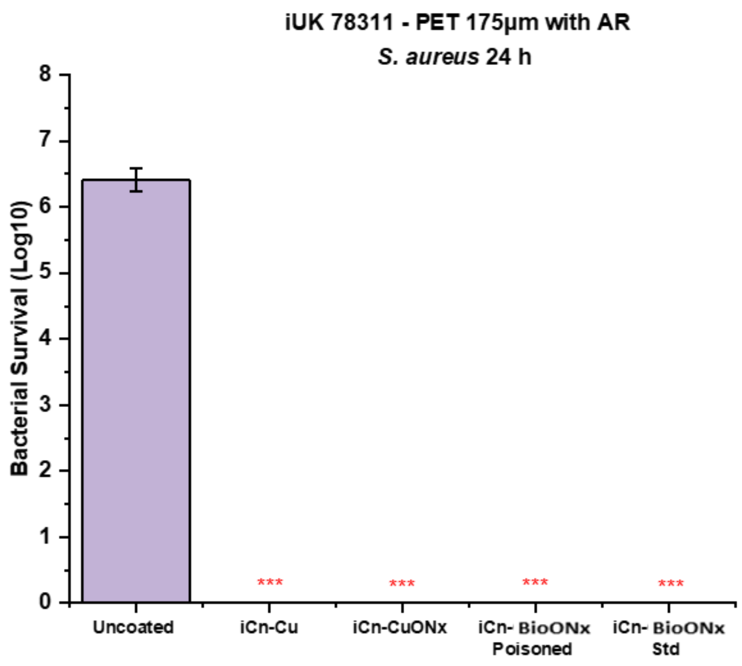
Gencoa Miller Test Results

3 months in the Field

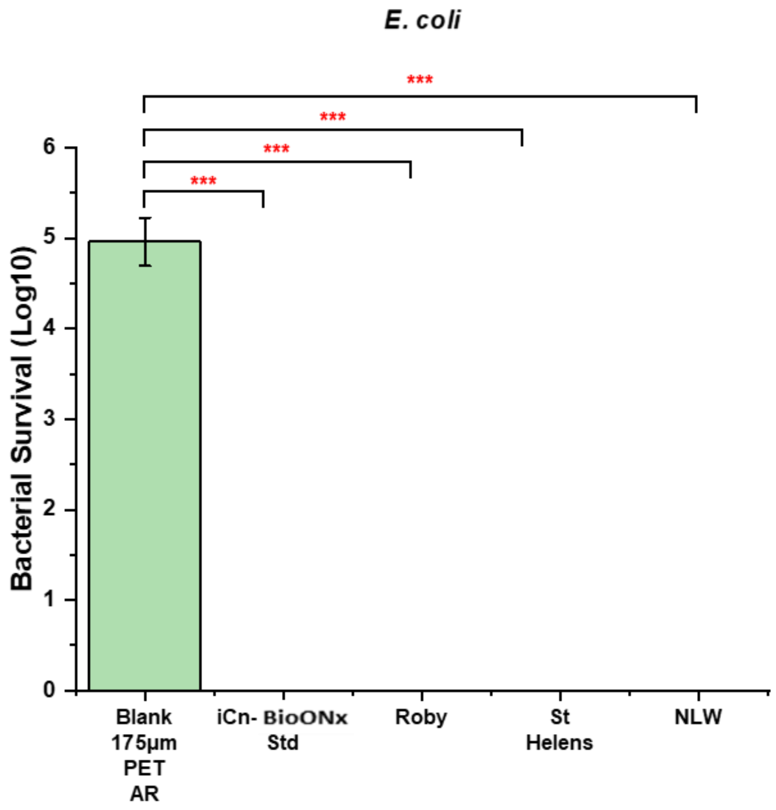


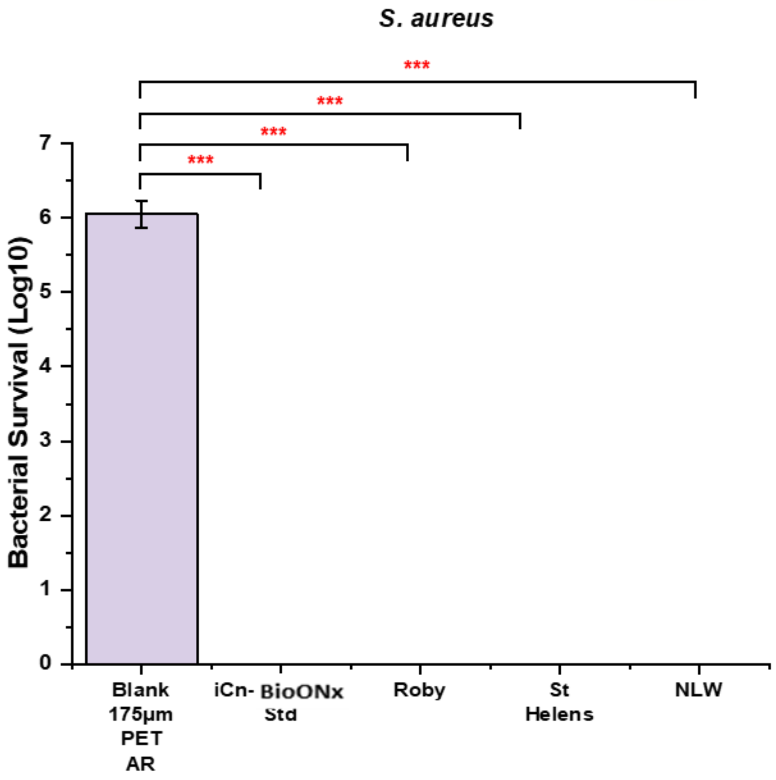
Antibacterial surface assessment conducted using ISO 22196:2011 (optimised).





Relative to the control (uncoated PET) over 24 h, all coated surfaces displayed a >6 log reduction for *E. coli* (Gram-negative) and *S. aureus* (Gram-positive).

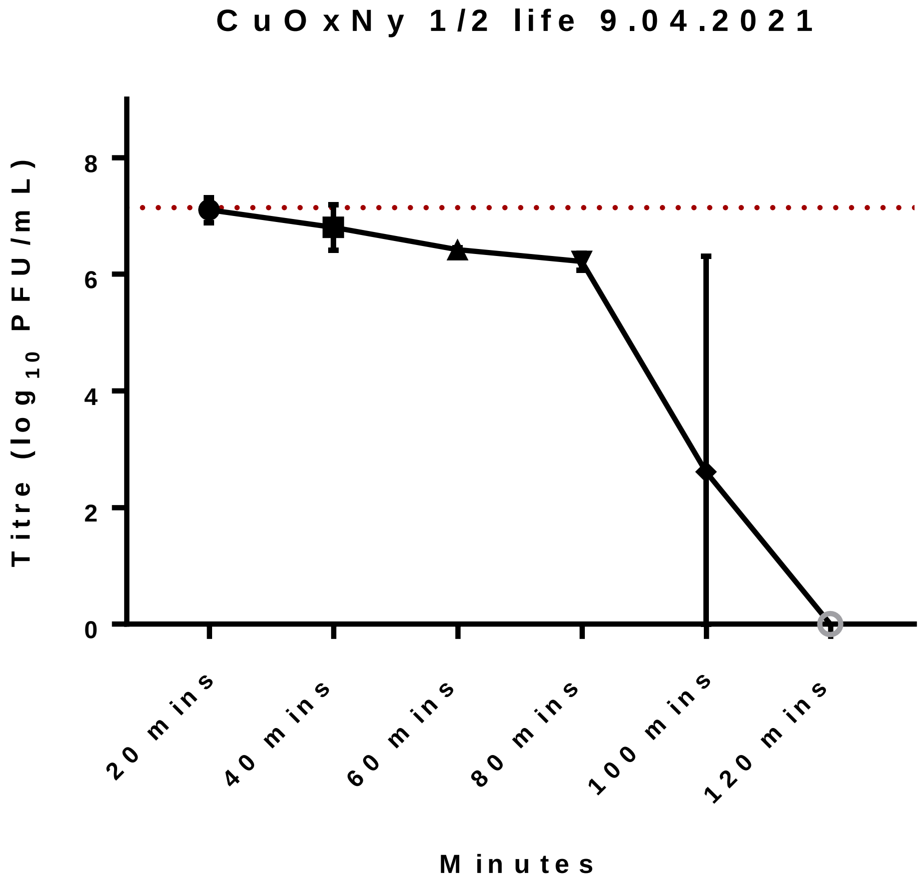




Results: <u>All</u> surfaces recovered from the trains stations showed comparable antibacterial activity to the unused iCn-CuONx Std surface, indicating antibacterial activity remained.

VIRAL STUDIES
PET coated with ICN Half Life of Sars-CoV-2

- 50uL of SARS-CoV-2 placed onto surface and left to incubate for the indicated time.
- Starting SARS-CoV-2 titre: 7.14log10 PFU/mL. Represented by red line on graph
- Half life between 80 mins and 100 mins
- Problems: Large SD at 100mins
  - Replicate 1: 0.0log10 PFU/mL
  - Replicate 2: 5.23log10 PFU/mL
- Conflicts with data gained previously which saw a complete reduction of SARS-CoV-2 within 1 hour



Self-Sanitising Visor with AR Technology

Gencoa and production partner Diamond Coatings have developed visors with sputtered coatings with antireflective and biocidal properties (AR & AM/V)

Summary

- All forms of infection are best avoided in order to preserve the health of the individual and the impact on the wider society and healthcare.
- PVD coatings with antimicrobial / antiviral properties can be produced.
- Gencoa have developed very thin, solid state, antiviral / antimicrobial surface coatings which can be applied to 3D parts or flexible adhesive film.
- These new copper based transparent coatings have been proven to kill 99.9999% (log 6) of microbes in light or dark environments.
- The layers are solid state and hard wearing > 12 months effective based upon touch screen trials.

Contact Details

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Thank you!

Please visit us at Booth 413