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A sol-gel-Coating

for permanently antimicrobial surfaces

Dr. Hans-Joachim Weintz

INTERREG
DEUTSCHLAND-NEDERLAND
AUTOPROTECT

A sol-gel-Coating for permanently antimicrobial surfaces

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Part of Interreg Project:

S²M – Sustainable Surfaces and Membranes

INTERREG Deutschland Nederland
Europäische Union
Europese Unie
www.deutschland-nederland.eu

2016 - 2018

Dr. Hans-Joachim Weintz

The S²M Network

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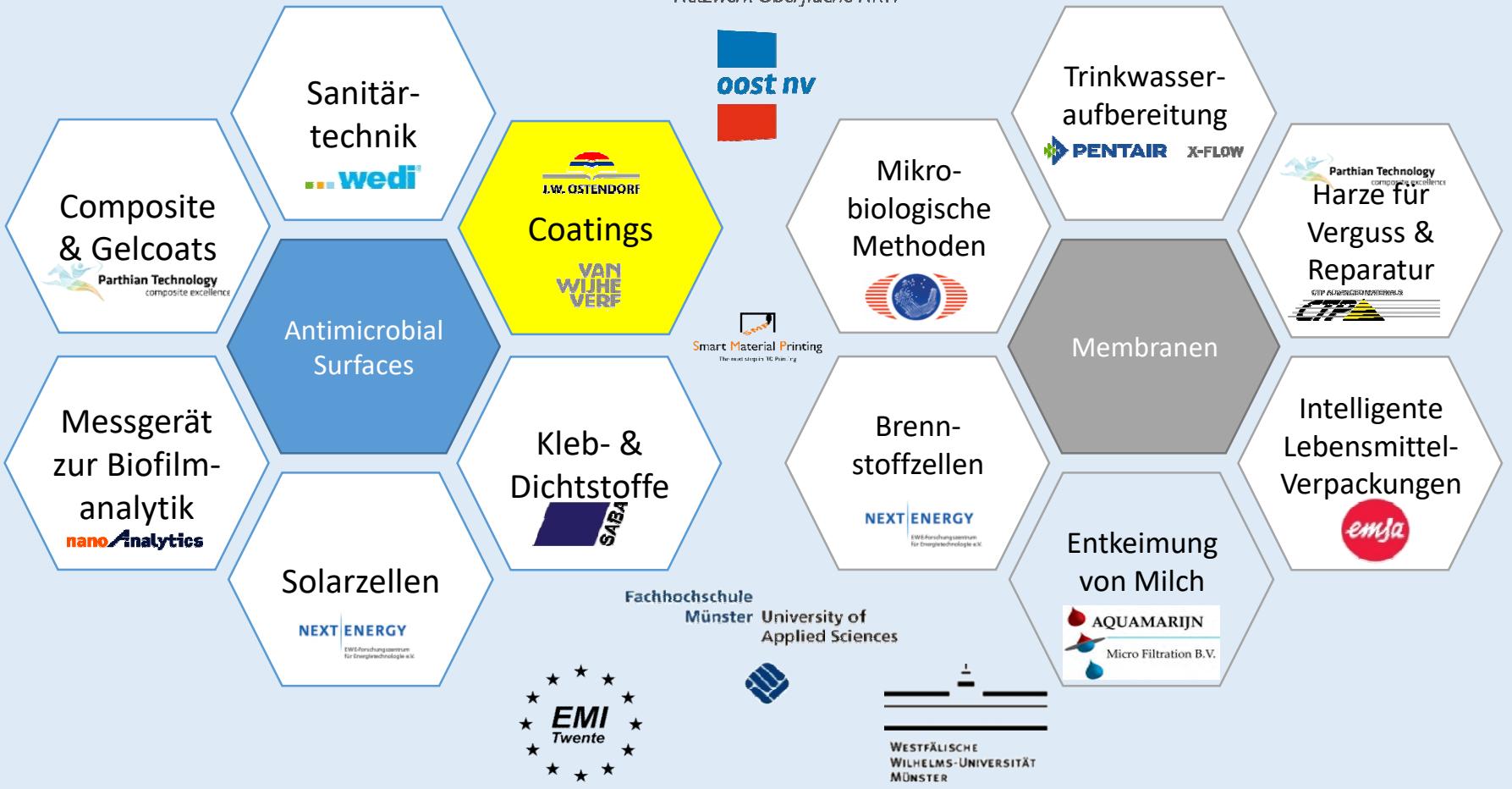


Scope S²M Coatings

Part 1: Polymer Biocides

Part 2: Anti Microbial Nanoparticles

Objectives & Expectations

Part 1: Polymer Biocides

- Incorporation of non-leachable, polymer-bound biocides into decorative and functional coatings

- Sustainable, protected surfaces for:
  - weather stable outdoor surfaces
  - sensitive indoor hygiene areas

- Substitution of common biocides for film protection

Part 2: Antimicrobial Nanoparticles

- Incorporation of non leachable ceramic POMs* into suitable functional coatings

- Sustainable, antimicrobial surfaces for:
  - sensitive indoor hygiene areas
    ➔ hospitals, senior nursery homes, public areas
  - wide range of substrates
    ➔ walls, metal, plastics, prepainted surfaces

- Substitution of common biocides for film protection

* Polyoximetalates, Source: Smart Material Printing

Challenge: find the right Polymer

Requirements

- Tough (hard and flexible => low filmbuild < 10 µm)
- Smooth and porous-free surface
- High chemical resistance against cleaning and disinfection agents
- Clear (if possible, almost invisible)
- Compatible with Polyoxymetallates (POMs)

➔ Material of Choice: Sol-Gel Clearcoat

Definition

Sol-Gel-Processes

.. describe the procedure for the production of non-metallic, inorganic or hybrid polymer materials from so-called soles. Sol is a liquid of dispersed colloidal particles or droplets (d=1nm to 100nm). Based on the size of the sol particles created, it often is spoken of chemical nanotechnology.

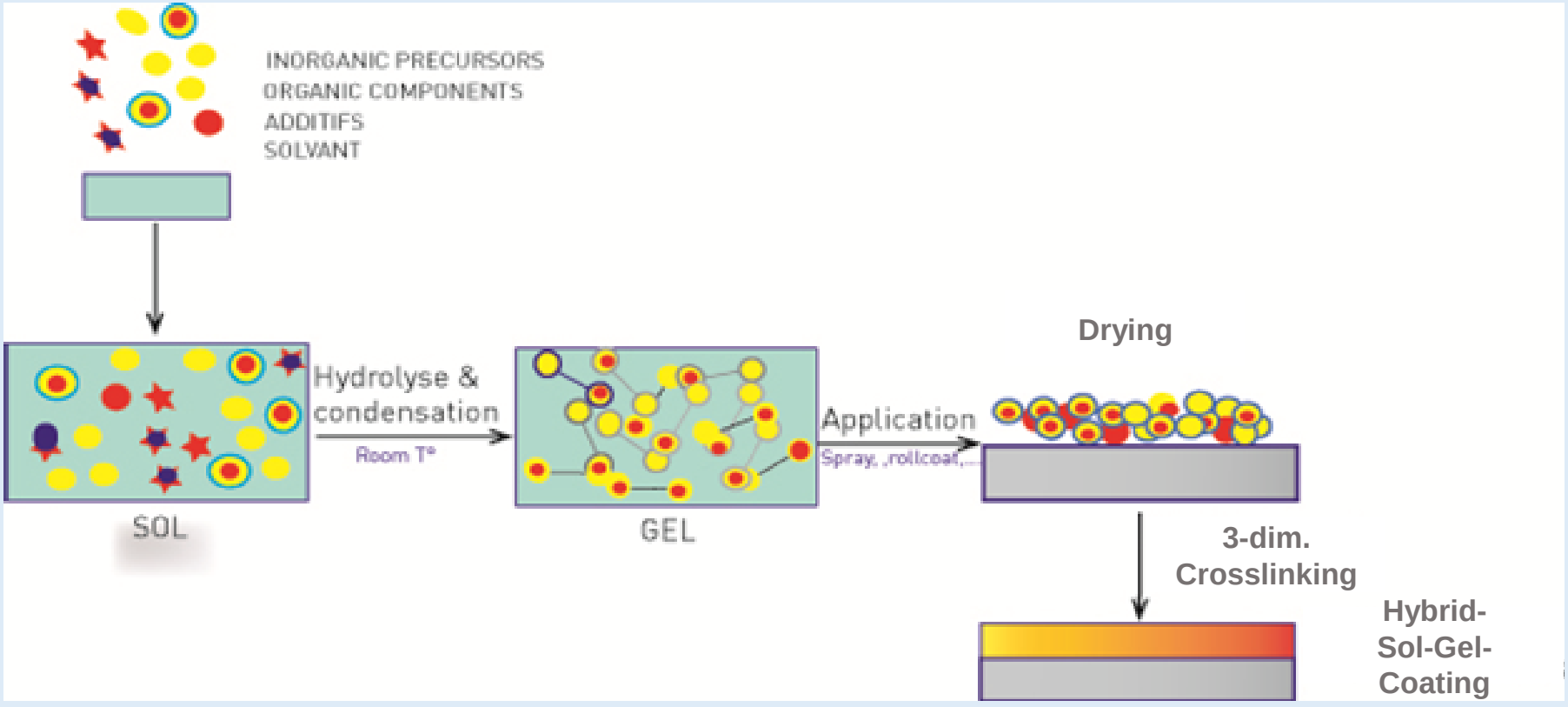
Sol-Gel-Coatings

.. are given properties that distinguish them from classic, organic-based paint systems. For example, they are characterized by very good hardness, abrasion resistance, transparency and chemical resistance.

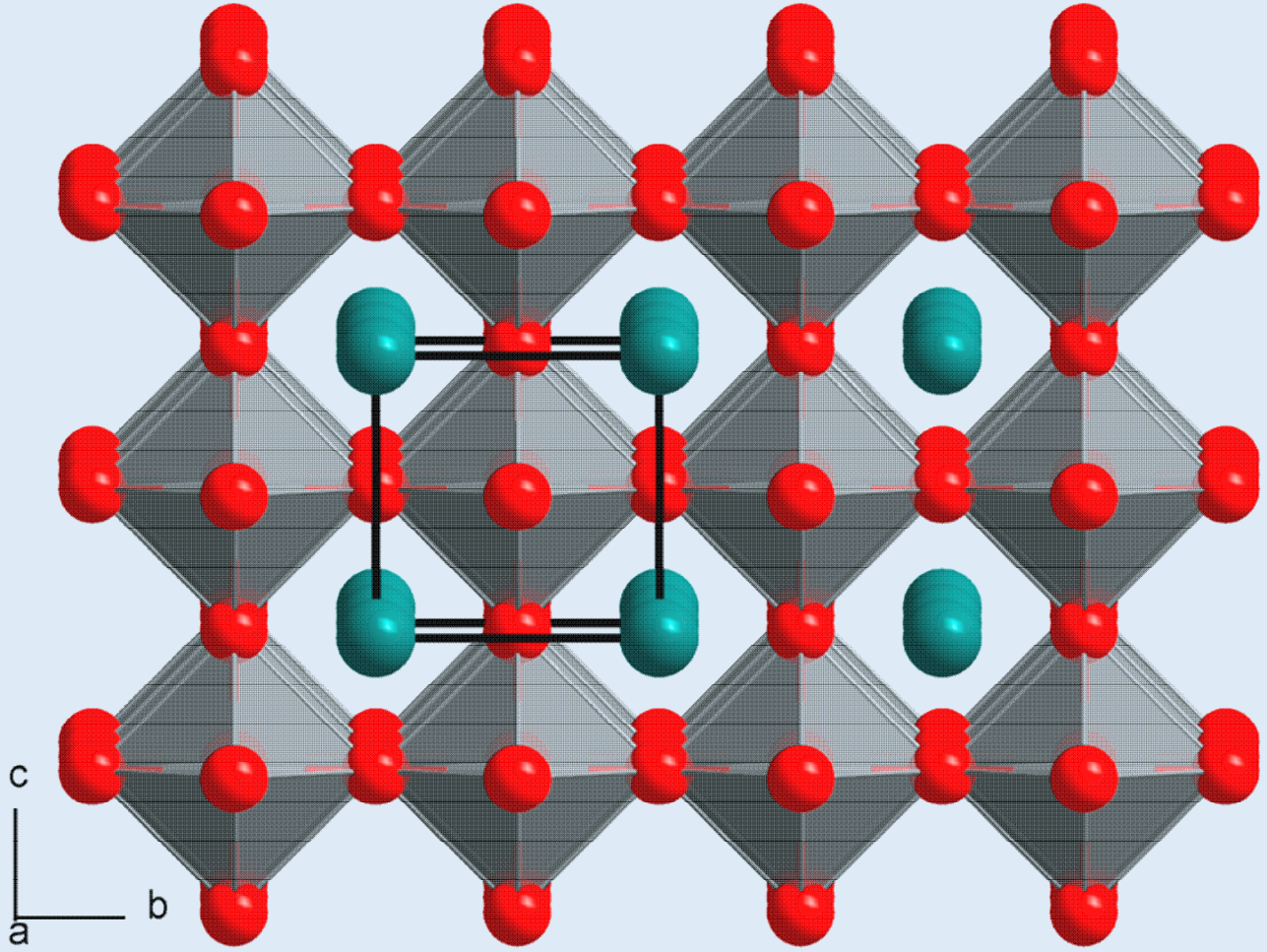
Through combination with organic components, so-called hybrid coatings can also be produced, which combine the properties of inorganic and organic coatings like hardness and elasticity, transparency and mechanical and chemical resistance.

Polymer Formation

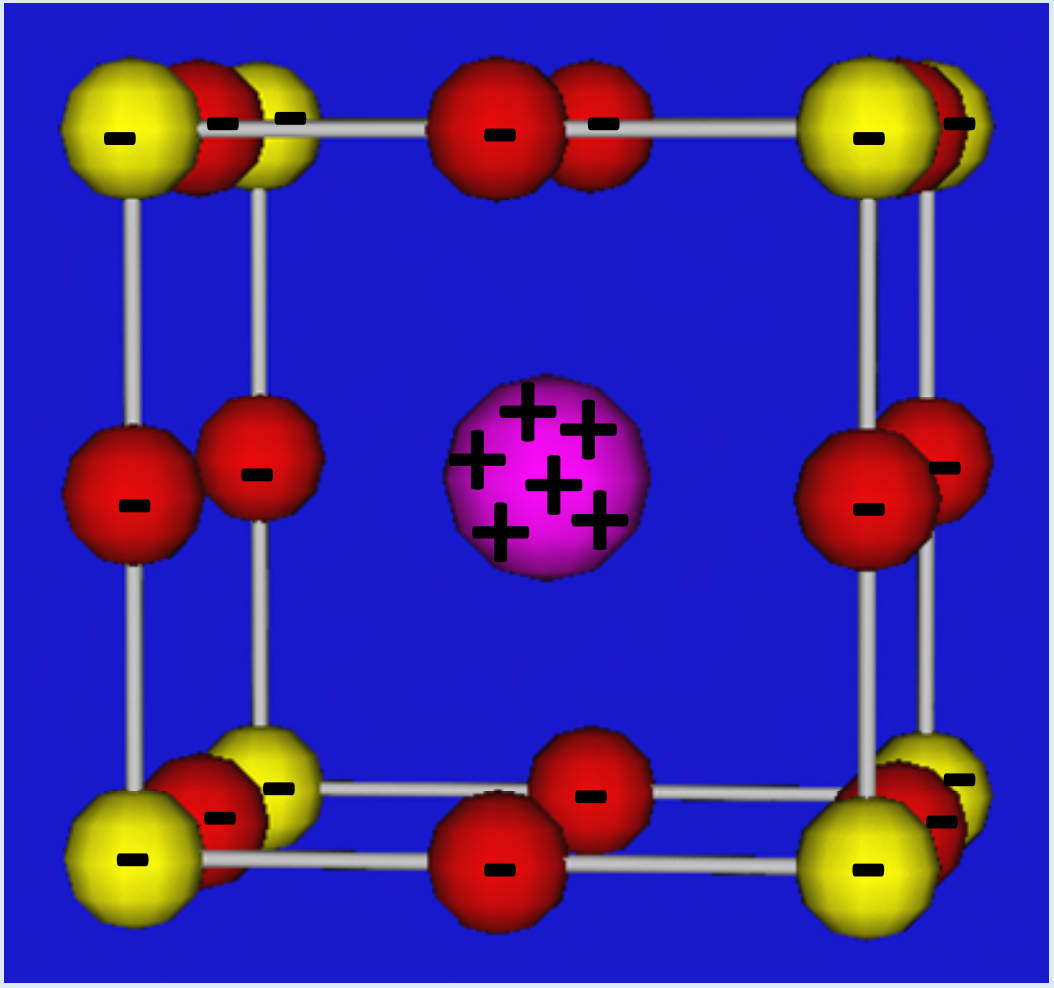
Sol-Gel Clearcoat



Antimicrobial Ceramics - Perovskite Structure



Simplified Perovskite-Structure



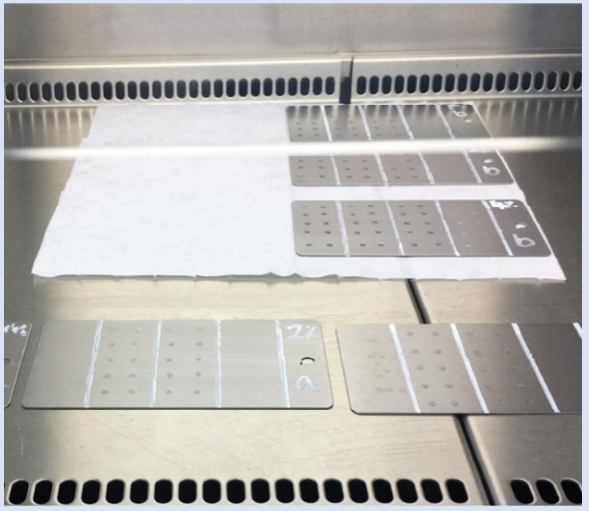
Polyoxymetalates (POMs) - Scope

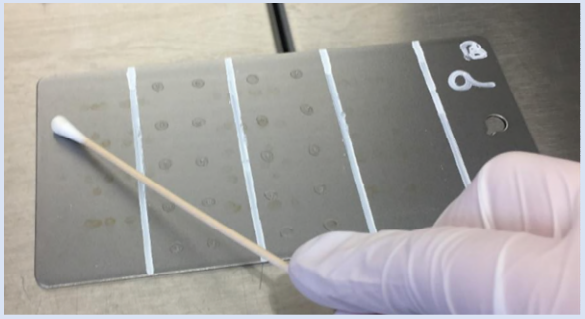
- Incorporation in sol-gel coating formulation possible
- Lab test performed at Christophorus hospital Coesfeld*, showed an excellent, immediately starting biocidal activity against MRSA

*Prof. Dr. med. Lutz Freiherr von Müller; Institut für Labormedizin, Mikrobiologie und Hygiene

Test Method (acc. to EN 16615)*

- Substrates: steel panels coated with 5 micron *sol-gel coating* with 0, 2 and 4% POMs
- Disinfected with desinfection wipes and cleaned with 70% alcohol
- Inoculated with defined concentration of MRSA germs
- Drying for 30 min / RT
- Smear test with 0.45% NaCl soaked cotton wipes direct after drying and after 2 and 5 h
- 100 micro liter direct plus 10^{-1}, 10^{-2} and 10^{-3} reduction developed on Agar for 24h at 37°C at 5% CO_2

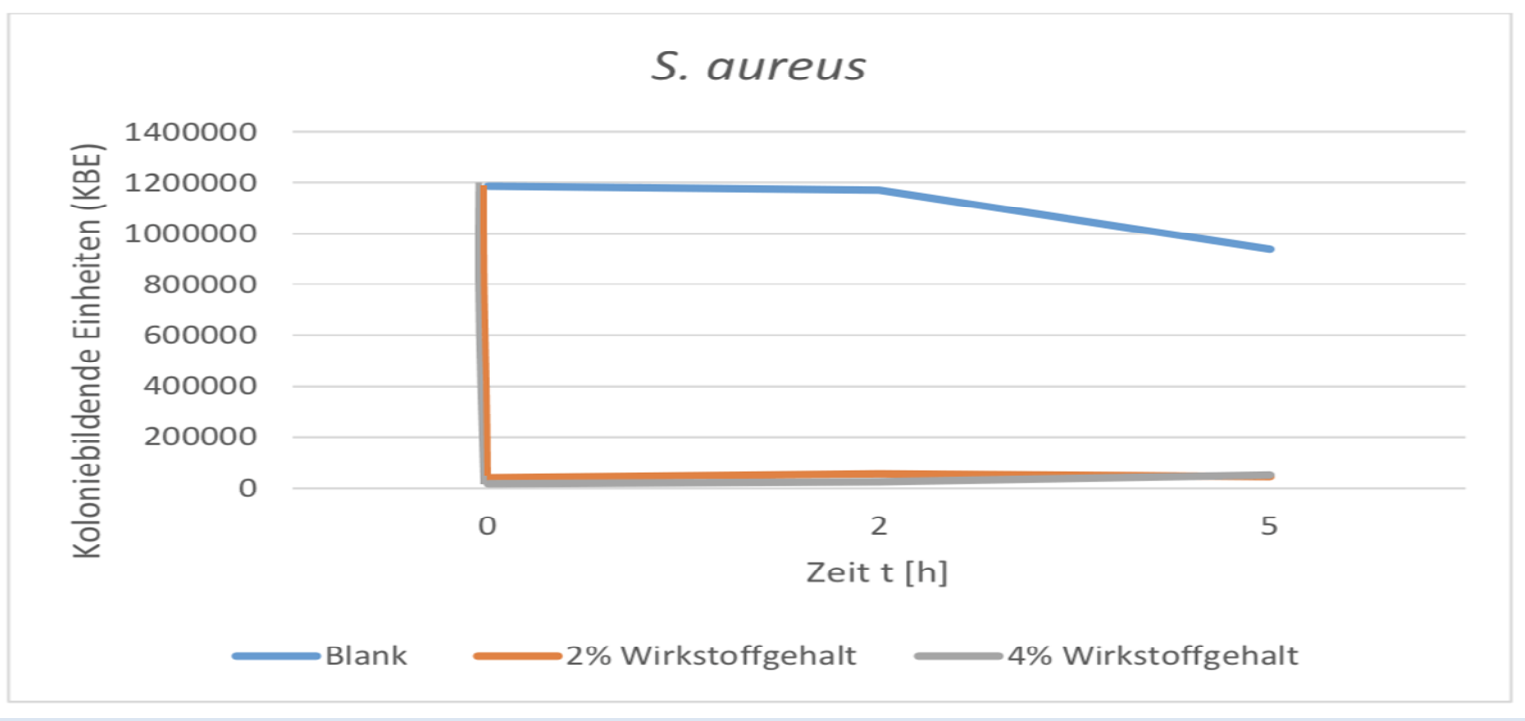




**Labtest by* Institut für Labormedizin, Mikrobiologie und Hygiene, Christophorus Hospital Coesfeld

Problem Organism: multiresistant bacteria (MRSA)

- Efficacy clinically tested at the University Hospital of Frankfurt and Christophorus Hospital Coesfeld



Reduction rates of Multi Resistant Staphylococcus Aureus (MRSA)

End of S^2M ➔ Foundation of itCoating GmbH (Febr. 2019)

"itCoating" = intelligent thin Coating

Product Areas

- itHygieneProtect
- itBoatProtect
- itIndustryProtect (incl. Anti-Graffiti)
- itHeatProtect
- itFireProtect

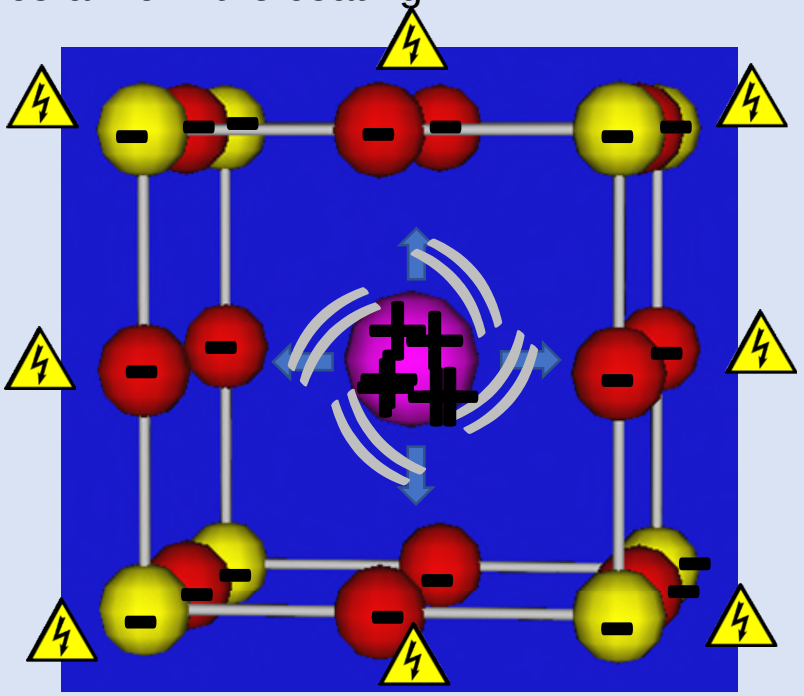
itHygieneProtect

- Easy application by wiping, spraying or brushing
- High yield; ideal layer thickness is below 10 µm
- Absolutely clear
- Physical action principle by a polymer embedded ceramic in the coating:

How *itHygieneProtect* works

- Distance variation due to *Brownian motion* between multiply positive charged heavy central metal atom and negatively charged oxygens causes fast transitions of their electrons between the energy levels
- This causes a jammer-like electronical signal which repels/kills the bacteria

➔ **"Electrical Fence effect" of it*HygieneProtect*"**



Perovskite grid of Polyoxometalate Ceramics

itCoating HygieneProtect and the Corona-Pandemic

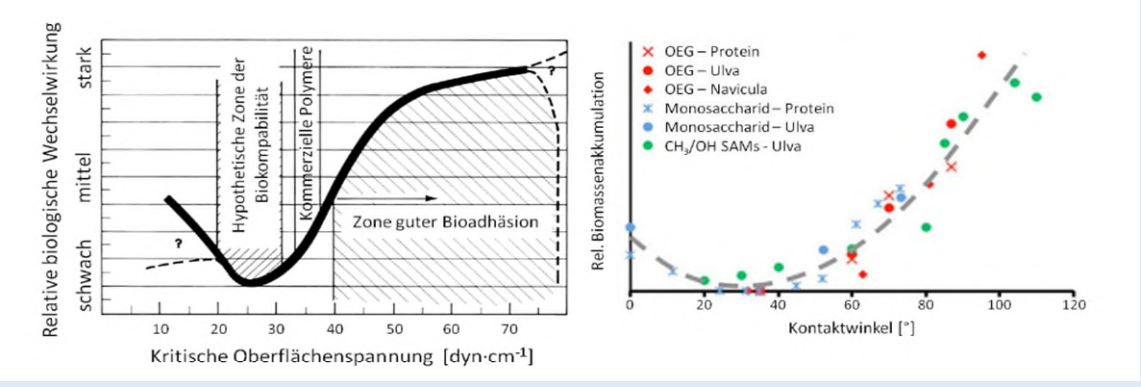
Boosted to combat enveloped viruses

Synergistic working Principle

1. Physical property: no grip – easy to clean surfaces

   - dense, hard, porous free coating

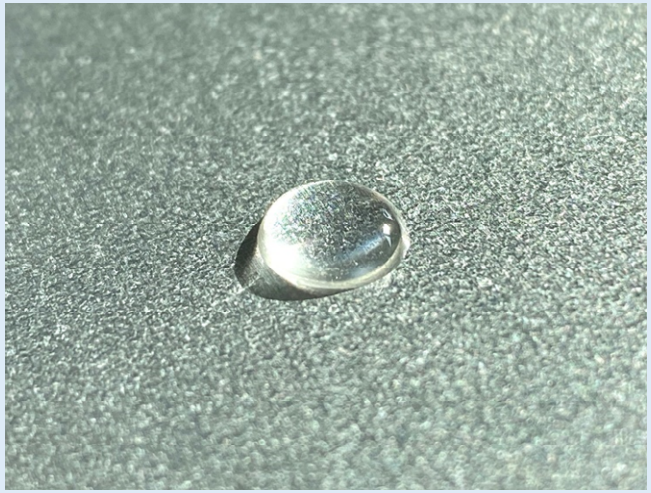
   - "Theta-Surface" (surface energy in minimum of Baier*-curve)



* Robert Edward Baier Journal of Materials Science: Materials in Medicine volume 17, Article number: 1057 (2006)

Easy to Clean Surfaces

Visualisation



itCoating HygieneProtect and the Corona-Pandemic

Boosted to combat enveloped viruses

2. Chemical attack

The biologically active compounds anchored in

itHygieneProtect attack the virus envelope.

As a result, the envelope becomes porous and the viruses is deactivated

Result:

Active surfaces that contribute to interrupt the infection chain

Activity tested against:

Bacteria

- gram-positive bacteria: Staphylococcus aureus*
- gram-negative bacteria: Escherichia coli*
- multiresistent bacteria: MRSA*

*(ISO 22196:2011)

Enveloped Viruses

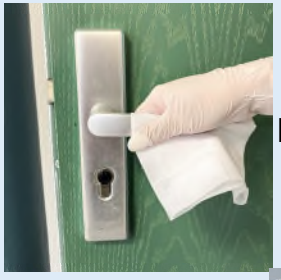
- Influenza A Virus H1N1**
- Bovinen Coronavirus**

**(ISO 21702:2019)

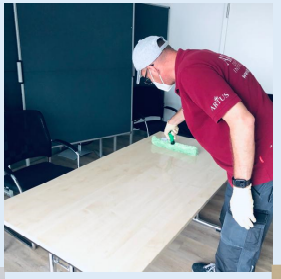
Compatibility tests:

- Dermatest (Subject group of 30 people, contact time 72 h, result excellent
- DIN EN 71-3 (2019-08) passed far below threshold

Application Areas: multi-Touchpoints like:

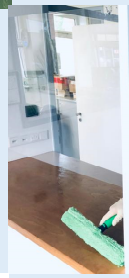


Door Handles

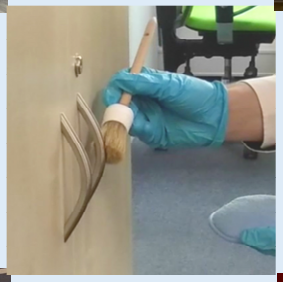


Tables

Handrails



Counters



Handles

Walking Frames

Window Handles

Armrests

Shopping Carts

Summary: Benefits at a Glance

Long lasting protection
Permanent and immediate reduction of bacteria and viruses for up to 3 years

Invisible protection
Transparent, thin-layered, resistant and odourless coating

Easy-to-clean Effect
The pore-tight surface makes cleaning easier.
Even stains, such as permanent markings or red wine, can be easily removed.

Eco-Efficiency
Coated surfaces can be easily cleaned with mild detergents.
Savings of disinfectants, reduction of the environmental impact due to solvents, low effort and time savings for cleaning staff.

Thank You!