

Novel Materials on the battle against Nosocomial infections

Prof. Dr. George Kiriakidis

PCN_{ano}
materials



Member of





Who we are

- Photo-Catalytic Nano Materials IKE (**PCN Materials**) is a spin-off company of the Foundation for Research and Technology Hellas (FORTH) based in Heraklion, Crete, Greece
- The company was created to commercialize **innovative, high-performance photocatalytic (P/C) nano-materials** that degrade gaseous and liquid pollutants, purify waste waters, disrupt polluting and toxic odors and degrade pathogenic organisms
- **Proved most effective on:**
 - **Improving air quality** (both indoors and outdoors), and
 - **Disinfecting health-sensitive areas** (destruction of bacteria, viruses, phages, etc.)



Global Problem

Pollutants



20%

European population has **asthma** or **allergies**

400,000

premature deaths in EU each year due to air pollution

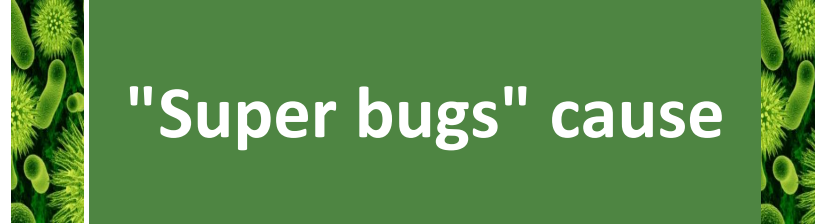
160,000

deaths due to **respiratory diseases** in US in 2019

4 billion € in healthcare

16 billion € in lost workdays

Pathogens



33,000 deaths in Europe

35,000 deaths in US

3,000,000 illnesses in US

Vulnerable spaces

COVID-19



An EU Problem in numbers... nosocomial infections

COVID-19

Facts:

- 6% of EU Hospital patients are infected by Supper Buggs/y
- 55% of ICU treated patients are infected
- More than 4.100.000/y experience a nosocomial infection
- 33000 mortalities are in direct link with nosocomial infections
- More than 110000 are in-directly associated with Supper Buggs
- Cost of Nosocomial infections treatment (in EU-28 /2016-17) : 8 BnEuro
- 50% Cost increase during the pandemic period (*ECDC report 2021*)



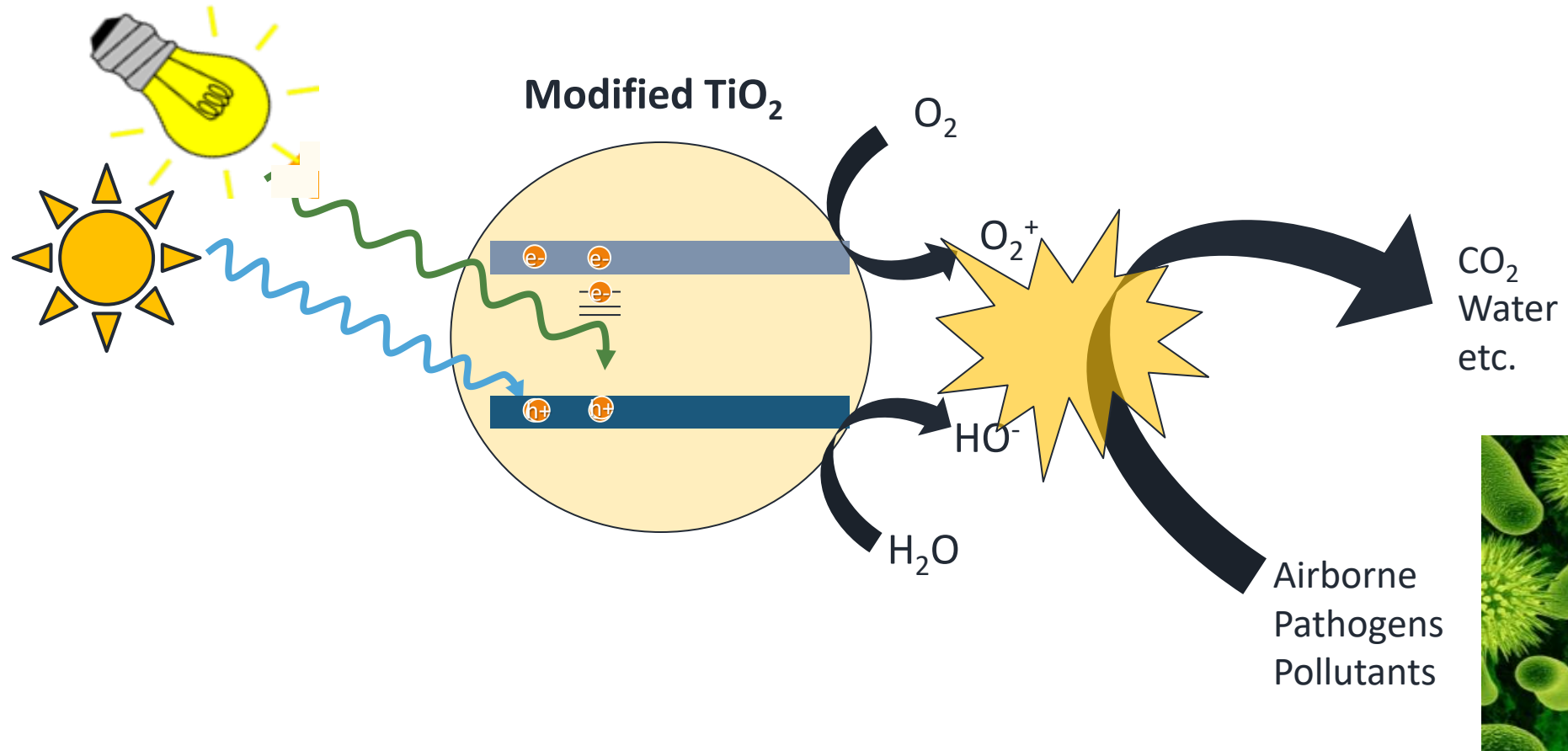
Global Problem... Supper Buggs

Current disinfection methods Characteristics

- ✓ **Ionizing Radiation** (no FDA-cleared/ High cost)
- ✓ **Dry-Heat Sterilizers** (nontoxic / slow rate / high temperatures)
- ✓ **Liquid Chemicals** (hard on barriers penetration)
- ✓ **Performic Acid** (fast-acting sporicide /no FDA-cleared)
- ✓ **Filtration** (questioned as sterilization method)
- ✓ **Microwave** (fast/high energy/ no FDA-cleared)
- ✓ **Glass Bead “Sterilizer”** (small glass beads/ high T/ short times)
- ✓ **Vaporized Hydrogen Peroxide (VHP®)** (limitation: cellulose , nylon becomes brittle/ no FDA-cleared)



Photo-Catalysis on indoor applications



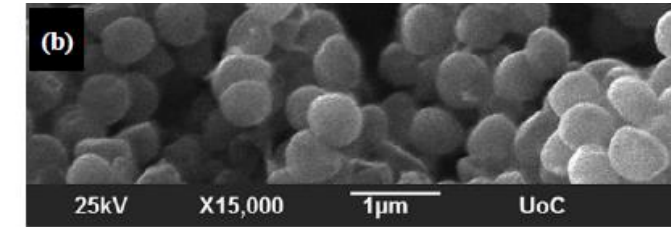
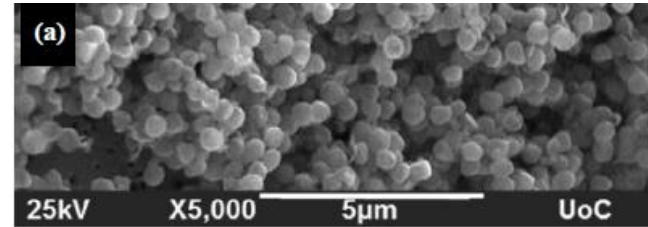
Destruction of Bacteria & Viruses

Reduction of indoor Nosocomial infections

Smart engineered material characteristics

Photocatalytic materials do light-induced reduction of healthcare-associated infections (HAIs)

- 99.99% reduction of pathogens in just 10 minutes
- Effective on Gram+/- Bacteria and Viruses
- Long-term **stability**/ Low cost
- **Self-clean** material on fabrics

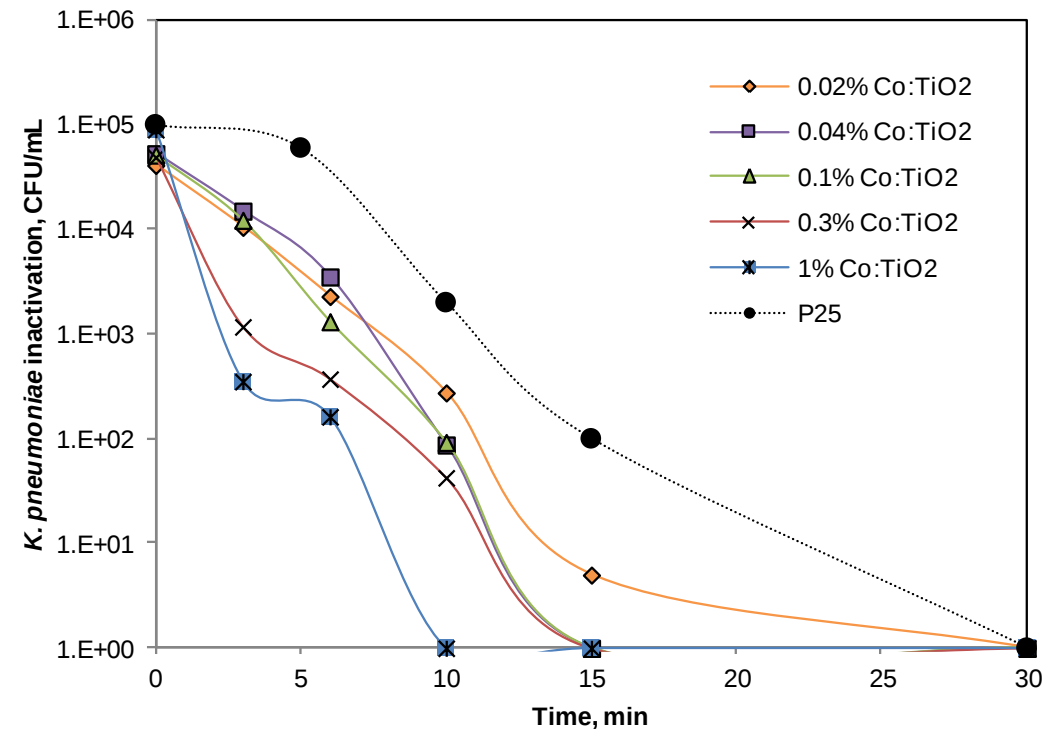
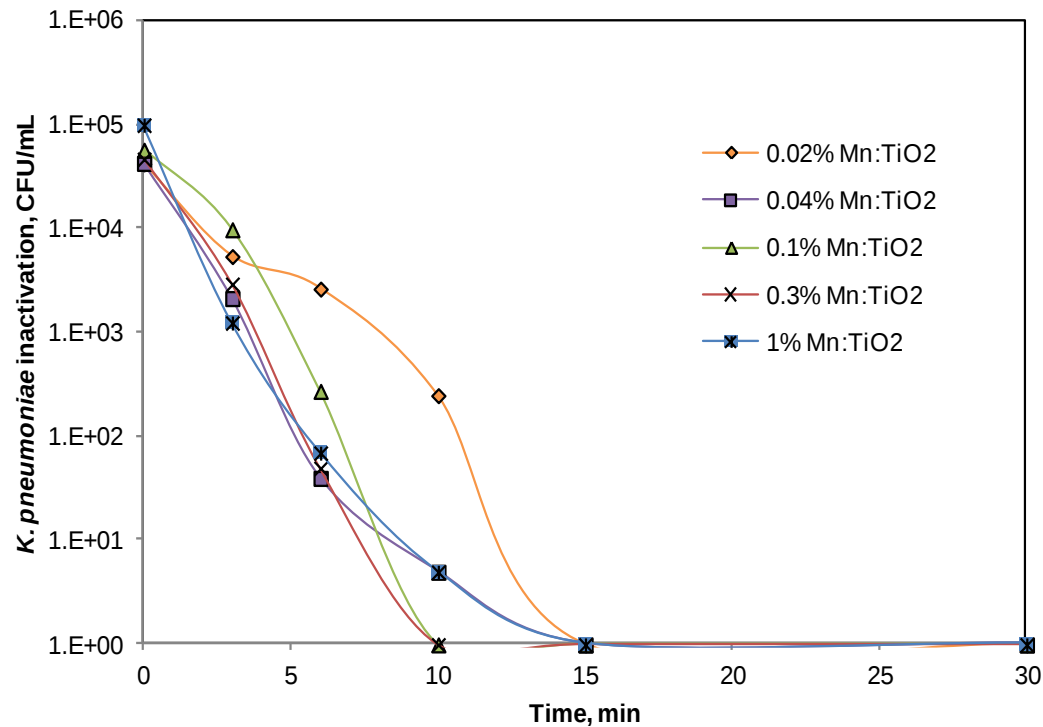


Tested on:

- ✓ Staphylococcus aureus (MRSA)
- ✓ Pseudomonas aeruginosa
- ✓ Escherichia coli
- ✓ Klebsiella Pneumonia
- ✓ Streptococcus
- ✓ MS2 Bacteriophage
- ✓ Lentivirus (**screening of SARS-CoV-2**)

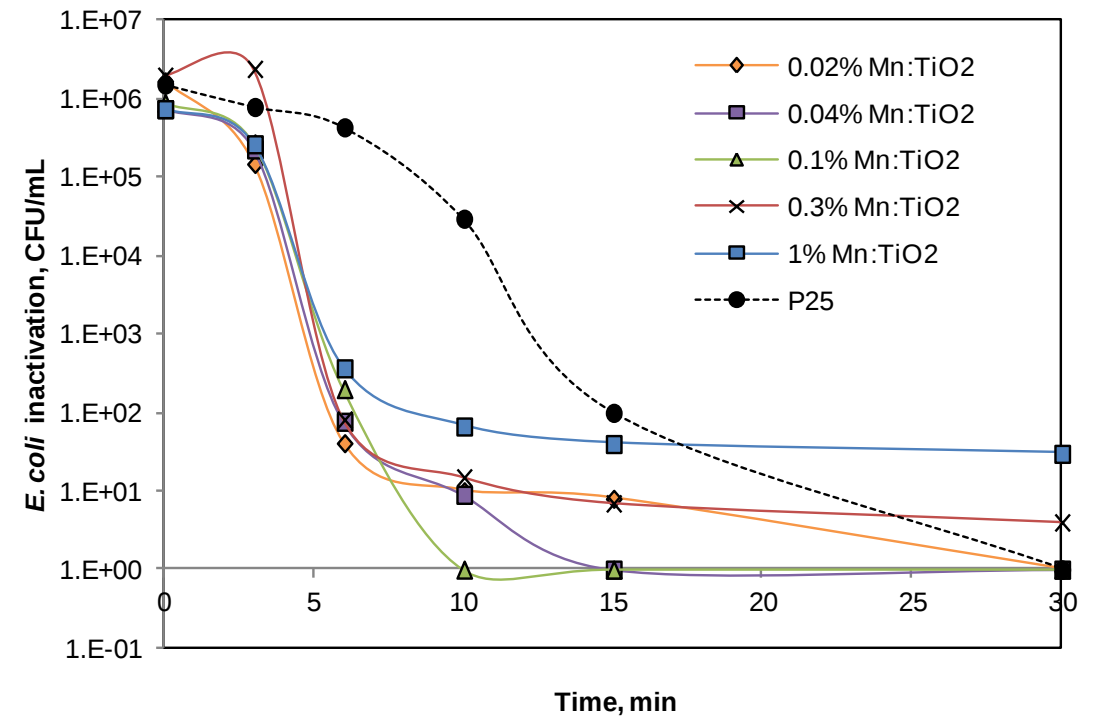
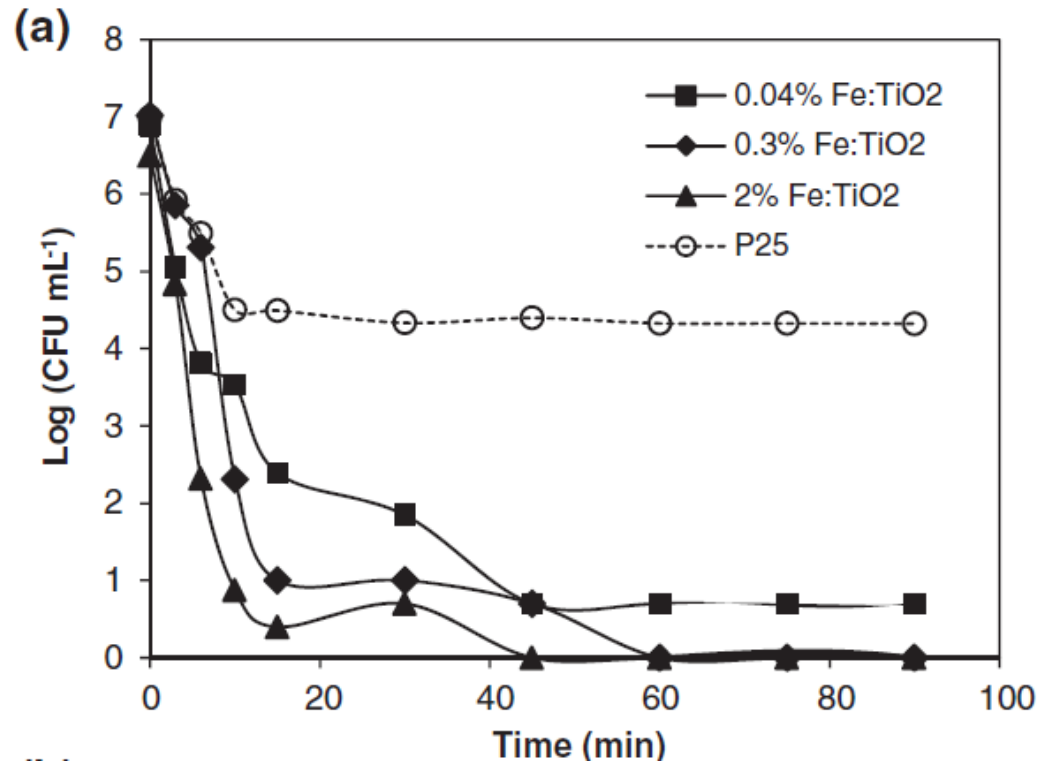
Super Buggs

Inactivation of *K. pneumoniae*



***K. pneumoniae* inactivation in the presence of different Metal-doped TiO₂ catalysts.**

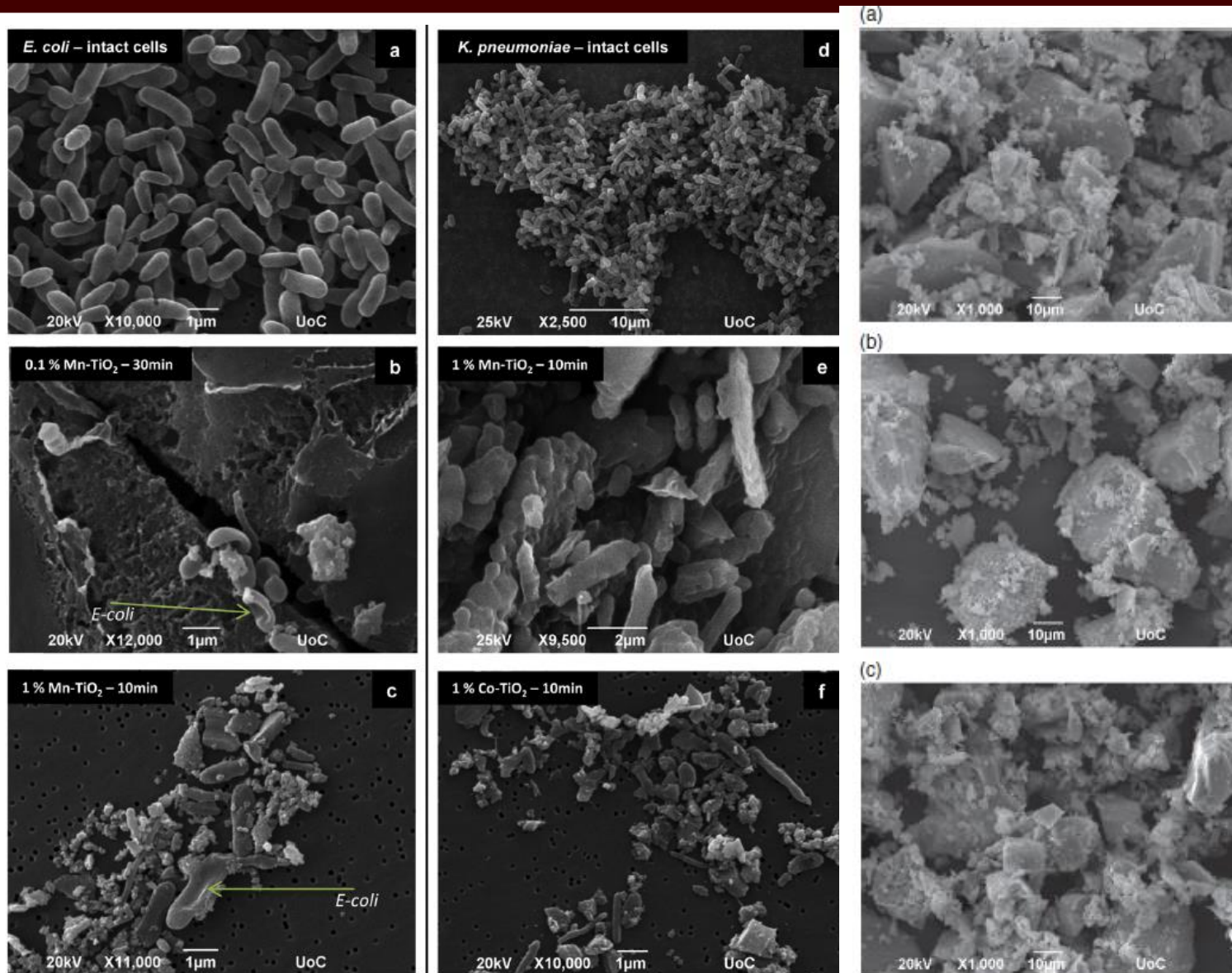
Inactivation of *Staphylococcus aureus* and *E-coli*



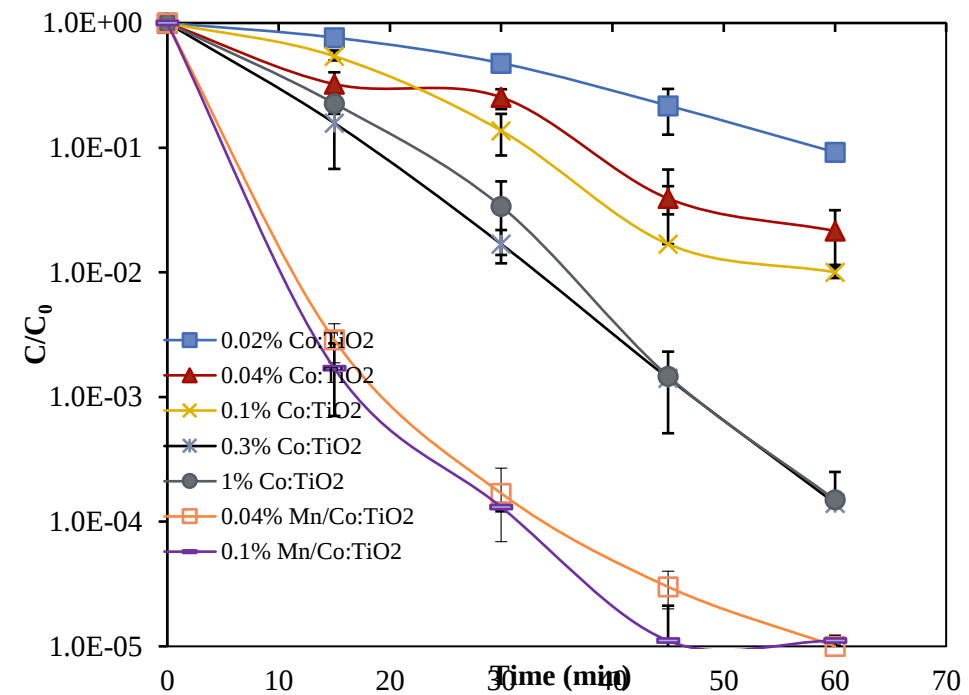
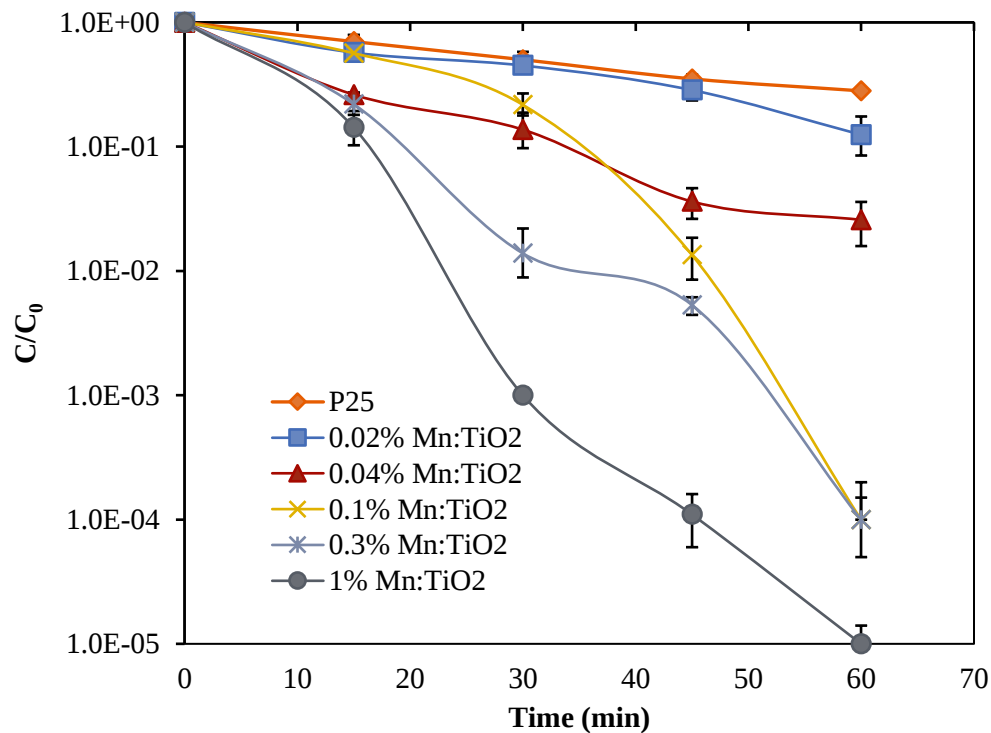
S. aureus and E. coli inactivation in the presence of different Metal-doped TiO₂

Inactivation of *e-coli*, *K. pneumoniae* and *S. aureus*

SEM Images without treatment and after photocatalytic treatment in the presence of metal doped TiO₂



Inactivation of MS2 Bacteriophage under visible light

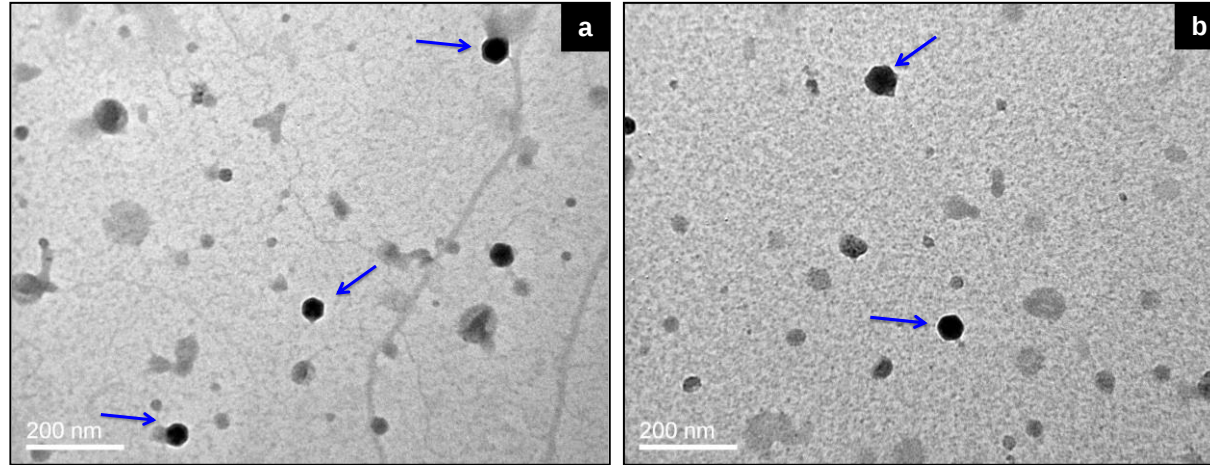


MS2 bacteriophage inactivation in wastewater in the presence of different Metal- doped TiO2 catalysts.

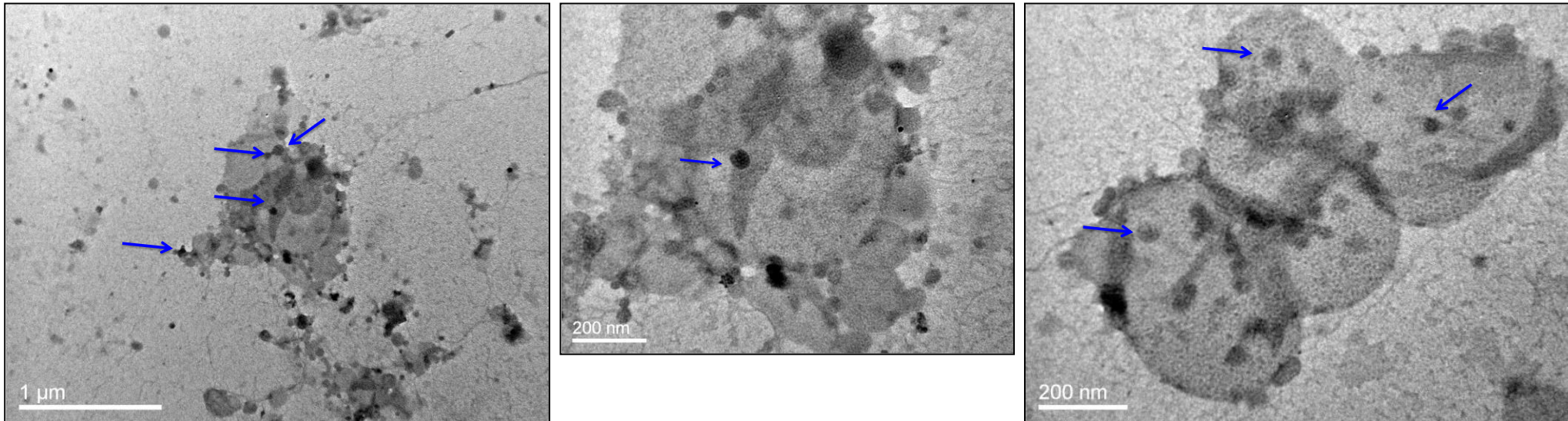
*Venieri D., Binas V., et al *Applied Catalysis B: Environmental* 154–155 (2014) 93–101

Inactivation of MS2 Bacteriophage

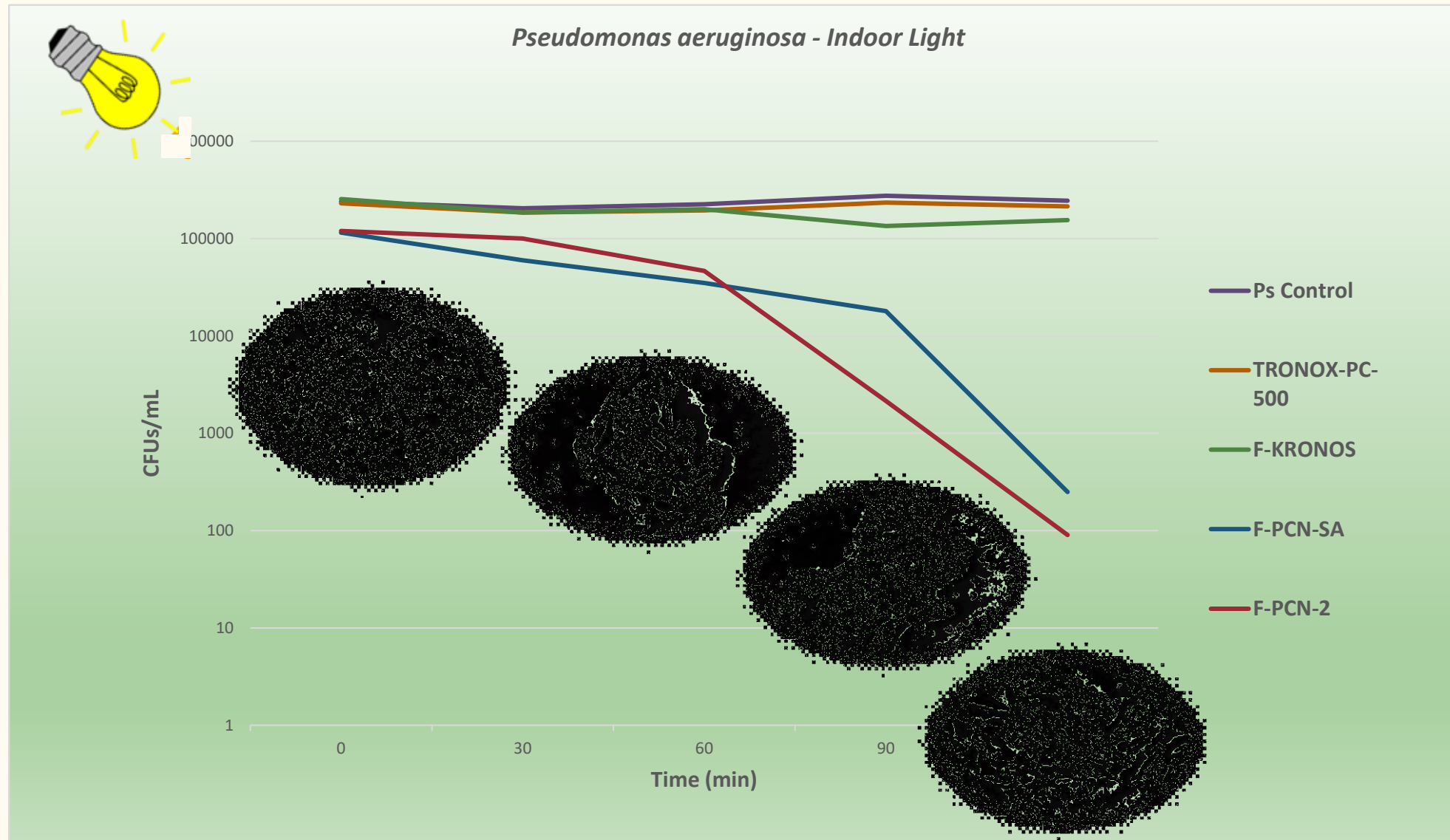
MS2 phages in samples before treatment



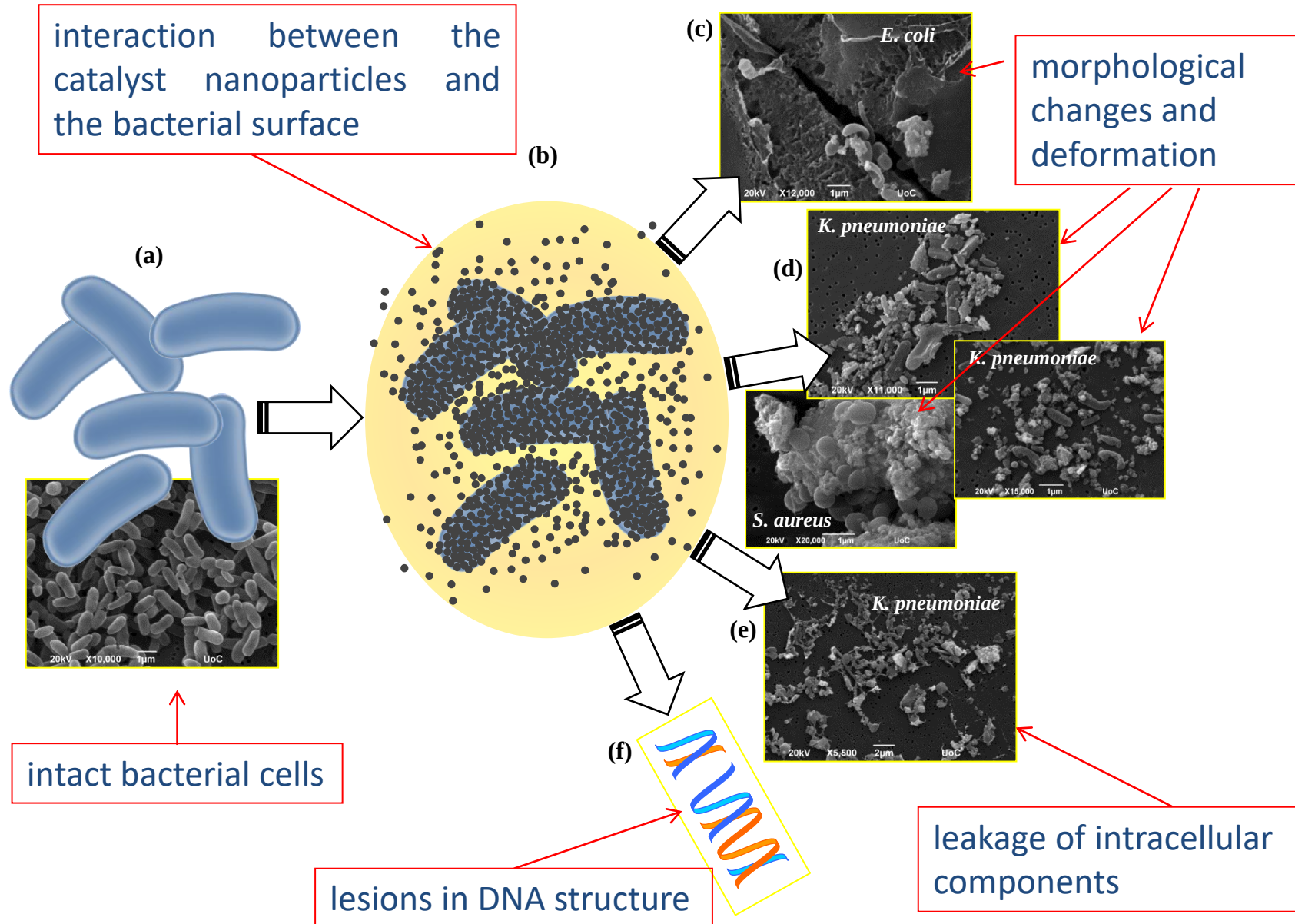
MS2 phages in samples after treatment with metal-doped titania



99.9% reduction in 120 minutes under ambient indoor light



The gradual process of bacterial inactivation through photocatalysis

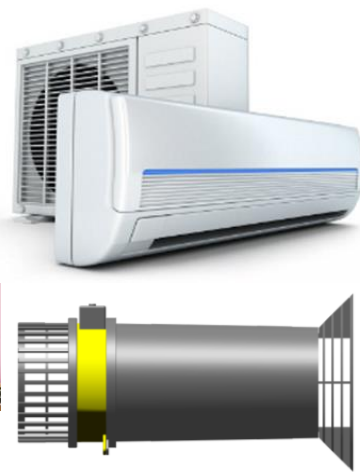


Applications / Potential Markets

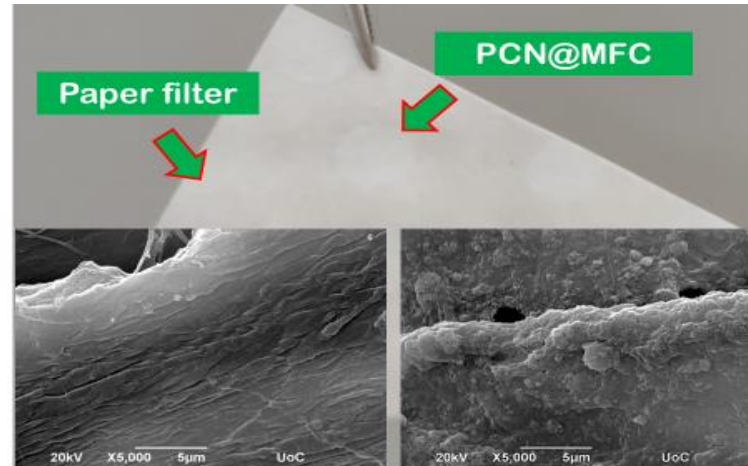
Paints / Coatings



Air conditioning & Sanitization systems



Cellulose and Paper



Powder paints/ Electrostatic Metal coating



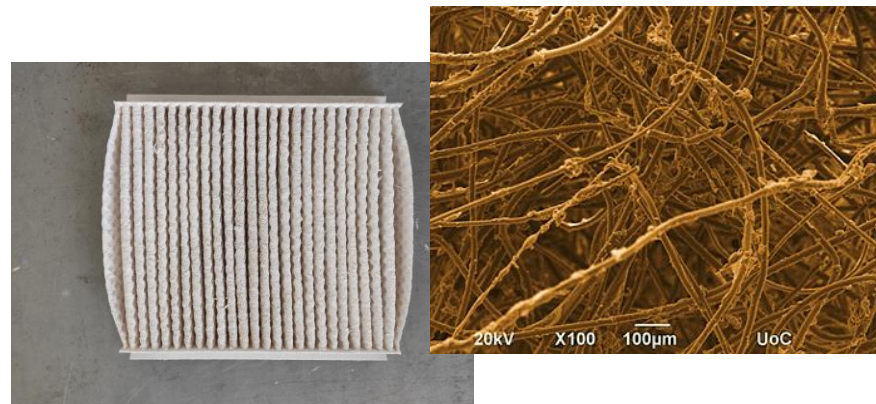
Textiles /Fibres



Cementitious products / tiles



Dust Filters coating

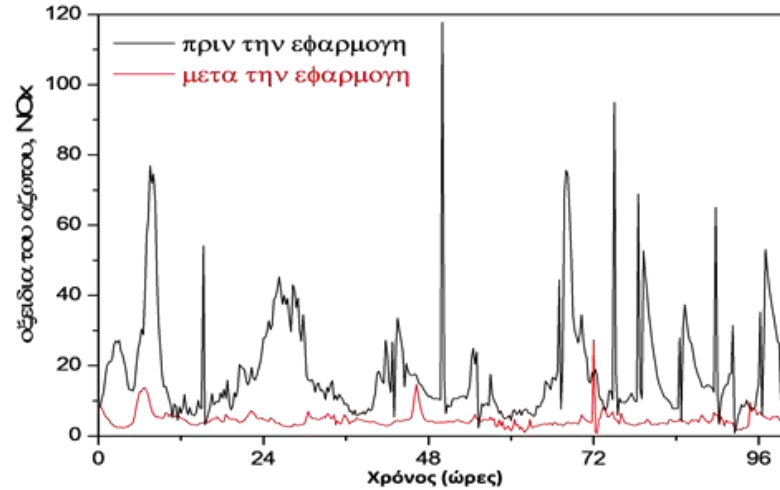


PLD Glass coating



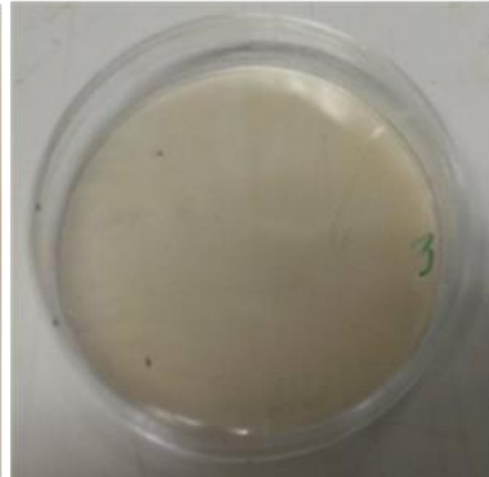
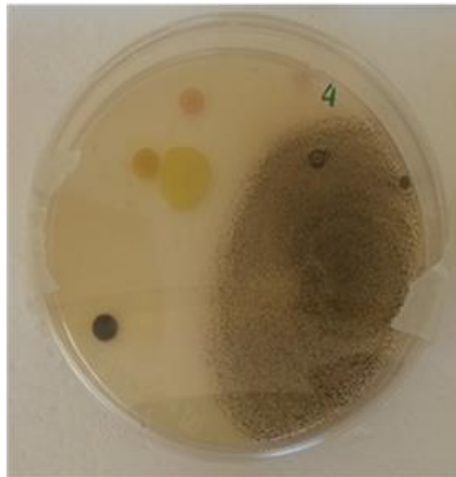
Large scale project / Validation

Join project / Greek Army Medical Centre



Before

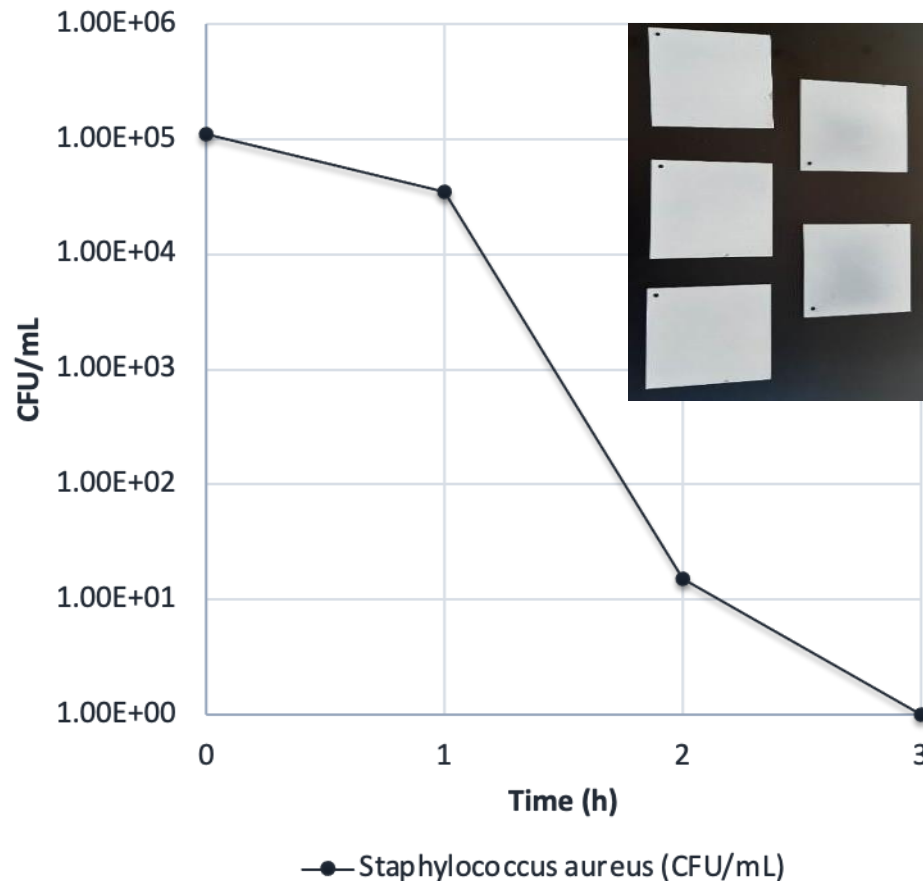
After



PCN Antibacterial activity on metal coatings

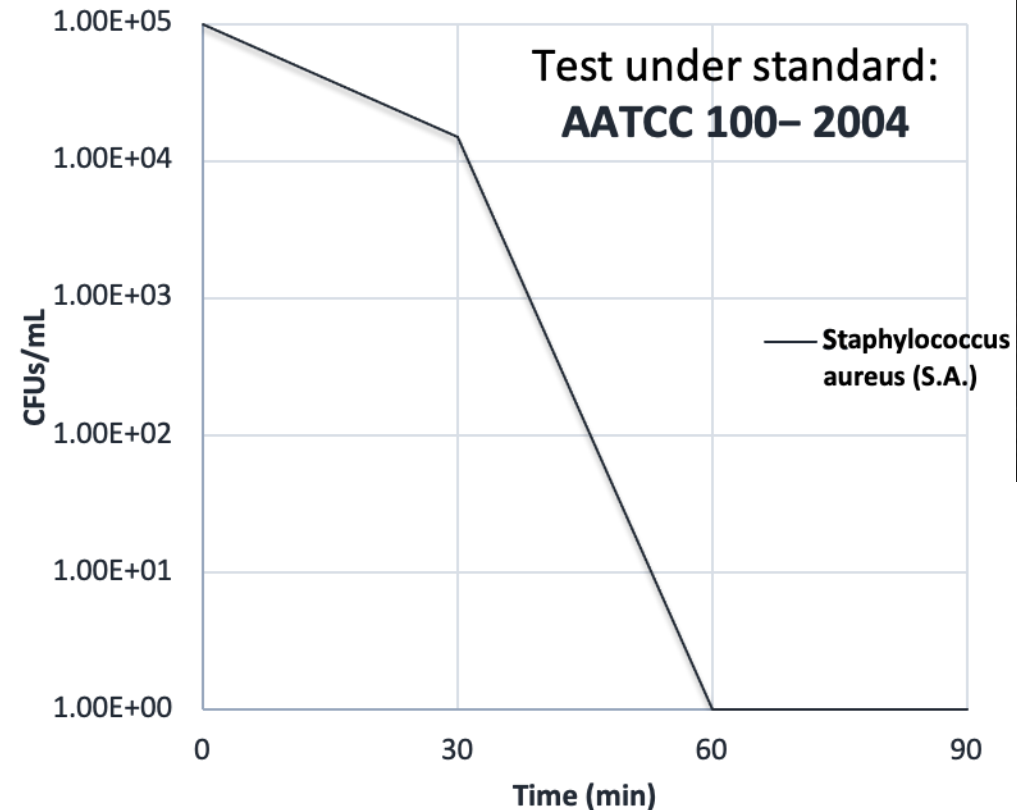
Global Powder paints manufacturer

PCN-2-KΔ-HB-150



Greek Powder paints producer

PP101/White/ : 10% PCN-1 (20-50μ)



Self cleaning attribute/ coated fabrics

0 seconds



15 seconds



36 seconds



Accreditation tests

Anti-Bacterial: Fabrics & Metals



Customer Name	PCN Materials IKE		
Customer Address	VIOPAN Anopolis, Hersonisos 70008, Crete Greece		
Contact	Professor George Kiriakidis		
Test Requested	Determination of antibacterial activity of photocatalytic materials according to ISO 27447:2019		
Sample Description	Medical fabrics (PCN 007)	Treated	Number Received 1 (3 x 4 cm)
	Medical fabrics	Non-treated	1 (A4 size)
Date of Receipt	12 August 2020		
ASC Code	ASC004013		
Commencement Date	02 September 2020		
Report Number	B708		
Report Date	14 September 2020		

ISO 22196
ISO 27447:2019
AATCC 100-2004

airmid healthgroup Ltd Unit 5, Trinity Enterprise Campus, Grand Canal Quay, Dublin 2, D02 VP76 Ireland
T: +353 1 6366220 E: info@airmidhealthgroup.com W: airmidhealthgroup.com
Directors: Dr Bruce Mitchell (Chairman and CEO), Dr John McFadden, Robert Jenkins, Hubert Lippert, Sergio Rullo. Co Reg. No. 444684 VAT Registration: IE0419332M
VIFM535 Page 1 of 6



广东省微生物分析检测中心 GUANGDONG DETECTION CENTER OF MICROBIOLOGY 分析检测报告 REPORT FOR ANALYSIS

报告编号
Report No. 2021FM22466R01D

样品名称
Name of Sample B-Gyros 空气消毒灯
B-Gyros air disinfection lamp

委托单位
Applicant 派尔可电机（东莞）有限公司
PELKO Motors

检测类型
Test Type 委托检测
Entrusted Test

单位地址：
Address: 广州市先烈中路100号大院66号楼
Building 66, No.100, Xianlie Middle Road, Guangzhou, China
邮政编码：
Postcode: 510070
电话号码：
Tel: (020)87137666
传真号码：
Fax: (020)87137668
网 址：
Website: www.gddcm.com

WS/T 648-2019



Thank you

Kiriakid@pcnmaterials.com

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