Materiali polimerici e tessuti antibatterici per applicazioni aerospaziali

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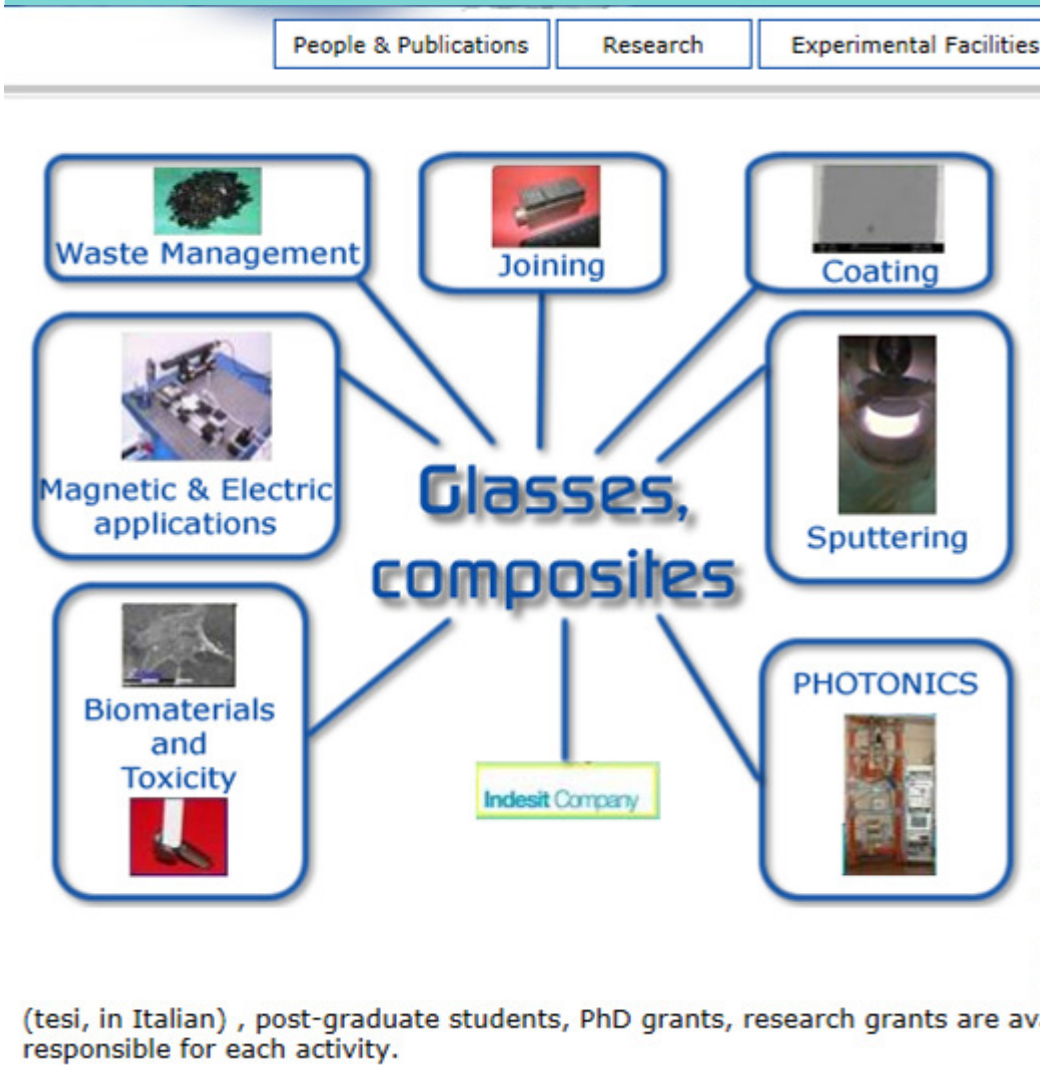
DISAT *GLAnCE – Glasses, Ceramics and Composites*

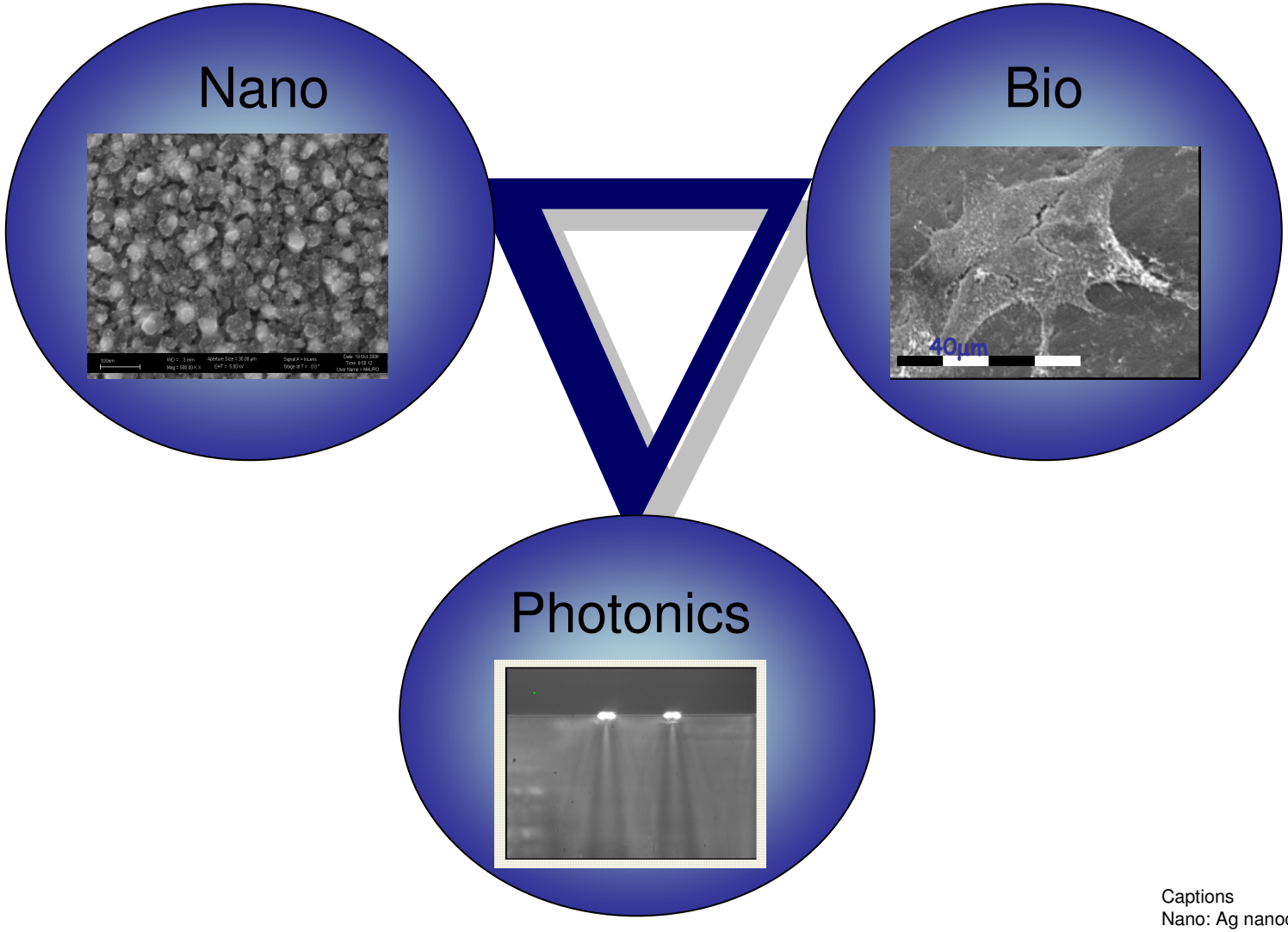


(tesi, in Italian) , post-graduate students, PhD grants, research grants are av
responsible for each activity.

"GLAnCE - *Glasses, Ceramics and Composites*"

"We prepare and characterize "custom" glasses, glass-ceramics and their composites, in the form of bulk-, joining-, coating-, porous- , thin films- and fibre-materials".

NABLA- Nanostructured AntiBacterial LAyers



Captions
Nano: Ag nanoclusters in silica
Bio: cell on a bioactive glass
Photonics: planar waveguides
Politecnico di Torino

1859-2009 150 anni di Cultura Politecnica

UNIVERSITÀ DEGLI STUDI DI TORINO
ALMA UNIVERSITAS TAURINENSIS

ISMB Istituto Superiore Mario Boella

ThalesAlenia Space

Reply Living network

Dipromed Dipro Medical Devices

NASLA- Nanostructured AntiSepticaL coAtings

Nanostructured AntiSepticaL coAtings

THE PROBLEM

BACTERIA ARE EVERYWHERE …

… ON THE HEARTH…

- **Medical devices**

- **Surfaces used by hundreds of people**

- **Surfaces for everyday-life**

… AND IN THE SPACE!

HOW TO SOLVE THE PROBLEM ?

… THE IDEA …

SILICA

Thermal, chemical, mechanical STABILITY

+

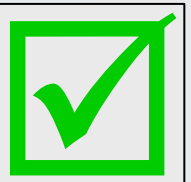
SILVER

well known ANTIBACTERIAL agent

BROAD SPECTRUM activity

LOW RESISTANCE development

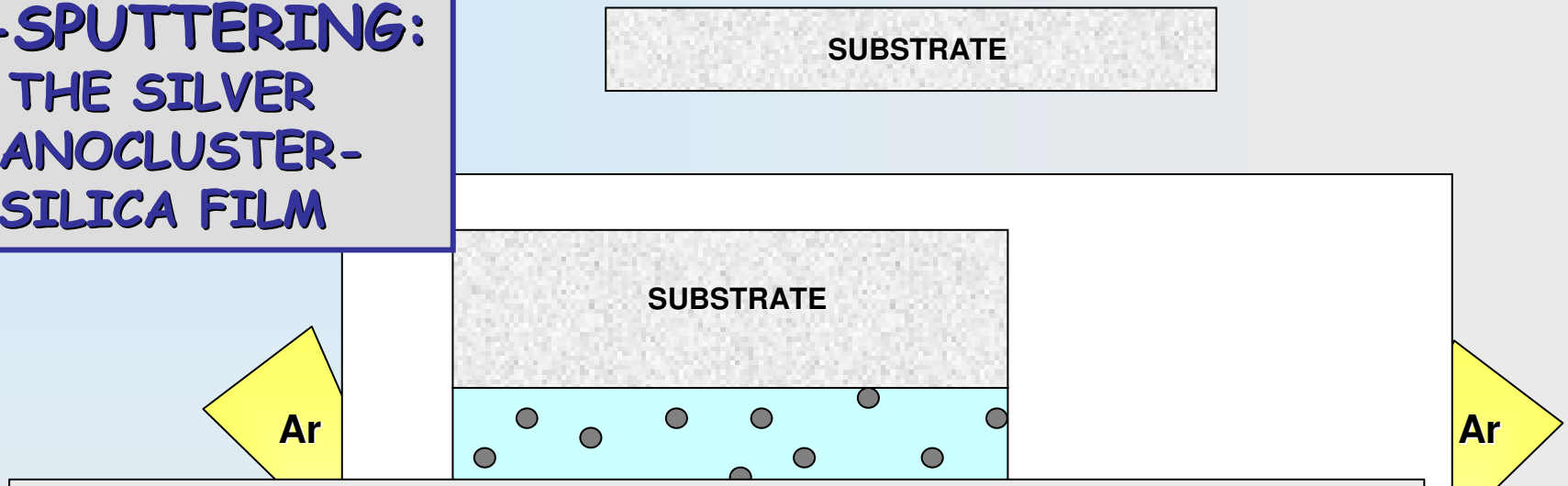
Stable, broad antibacterial spectrum, material developing low bacterial resistance



HOW TO SOLVE THE PROBLEM ?

… IDEAS FOR LAYER PREPARATION

CO-SPUTTERING: THE SILVER NANOCLUSTER-SILICA FILM

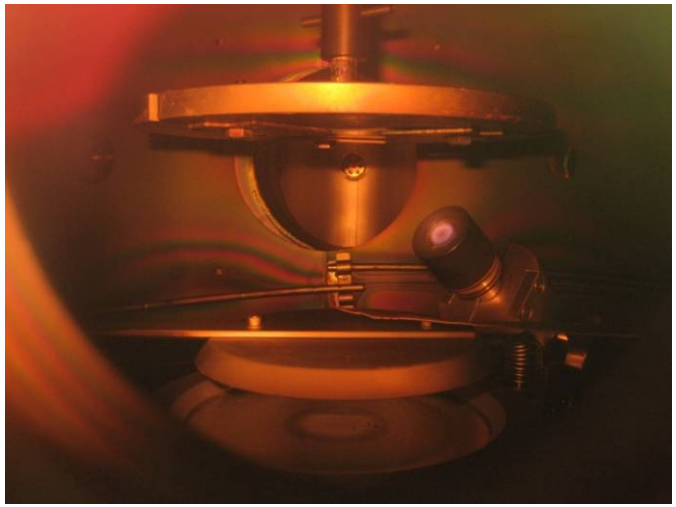


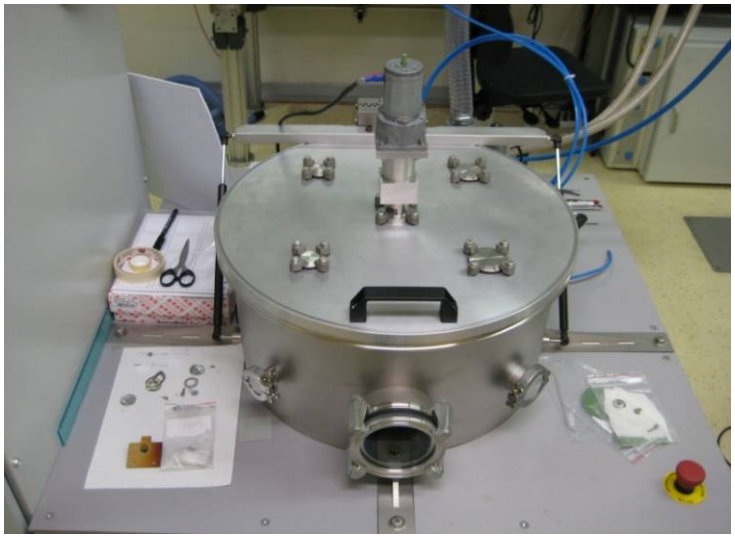
Sputtering technique to coat different surfaces

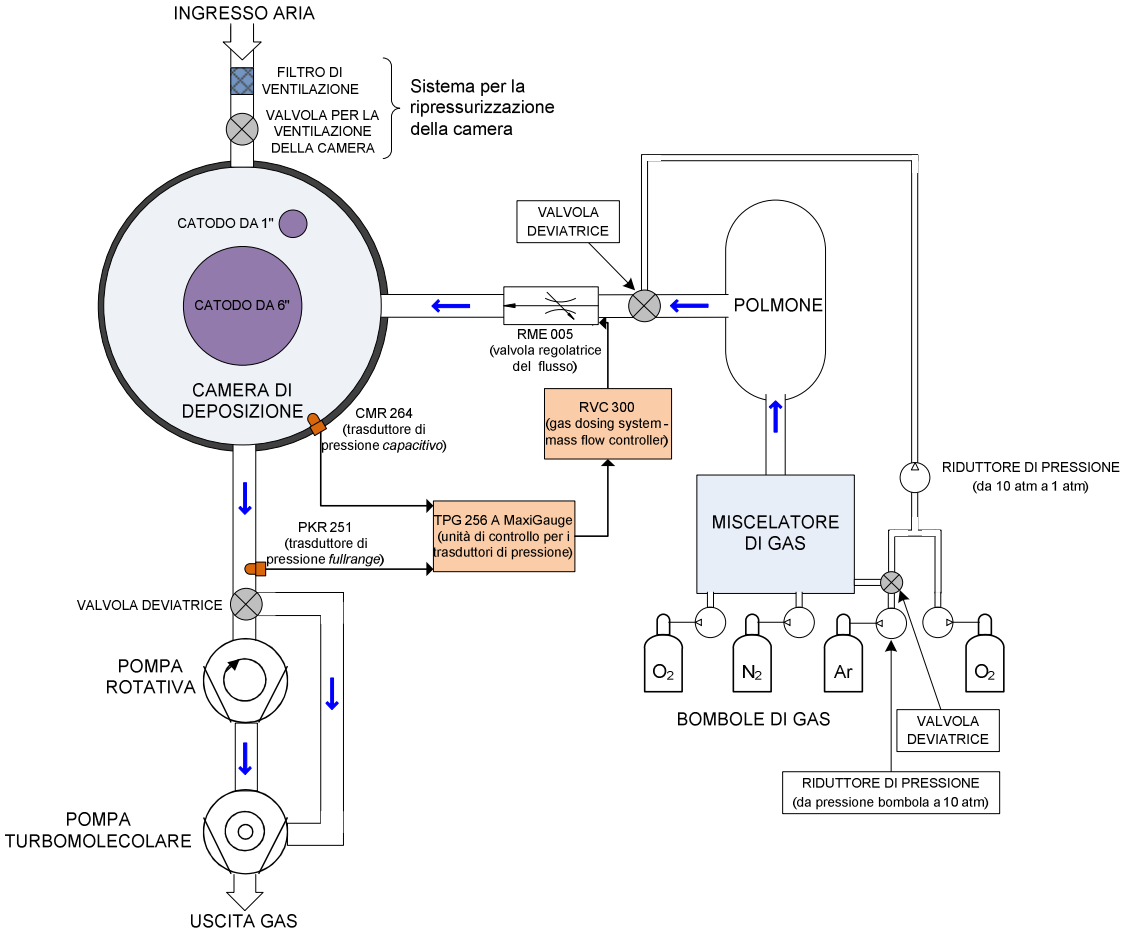
Deposition parameters to tailor silver content and release

The sputtering technique is widely used in industrial process and can be easily scaled-up.

OUR SPUTTERING







OUR SPUTTERINGs

3 TARGETS (2 inches)
RF, DC, PULSED DC co-deposition
Heating of substrates up to 450 °C
Cooling of substrates
Plasma cleaning/etching of the substrates
Ar, O2, N2 or mixed atmosphere available.

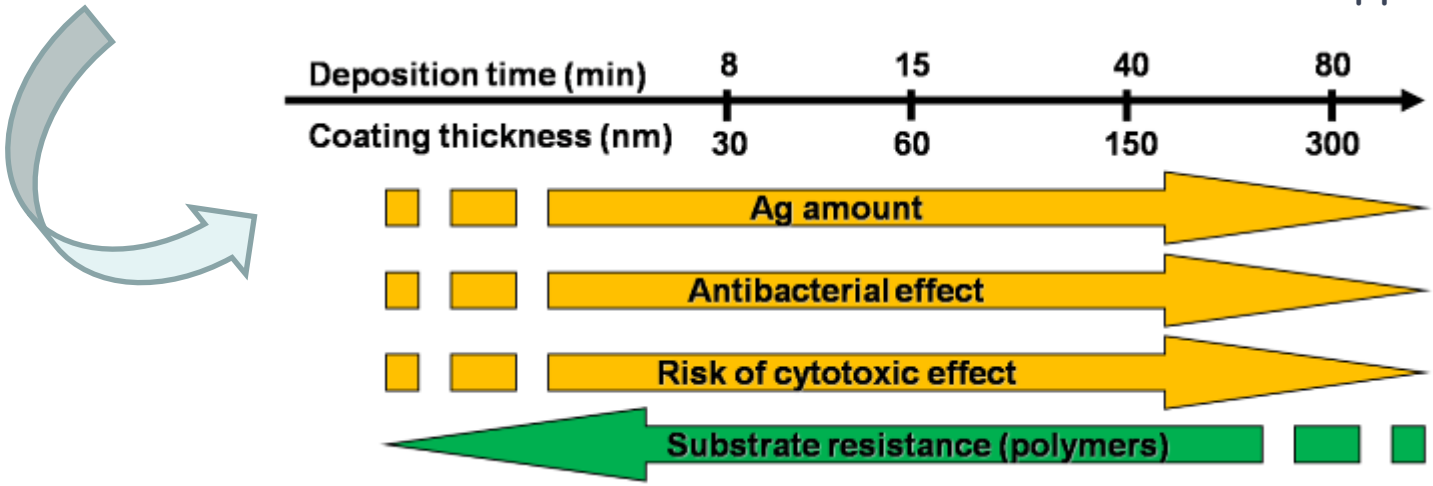
2 TARGETS (1 inch and 6 inches)
RF/DC or PULSED DC co-deposition
Ar, O2, N2 atmosphere available

CO-SPUTTERING TECHNIQUE

Sputtering Parameters

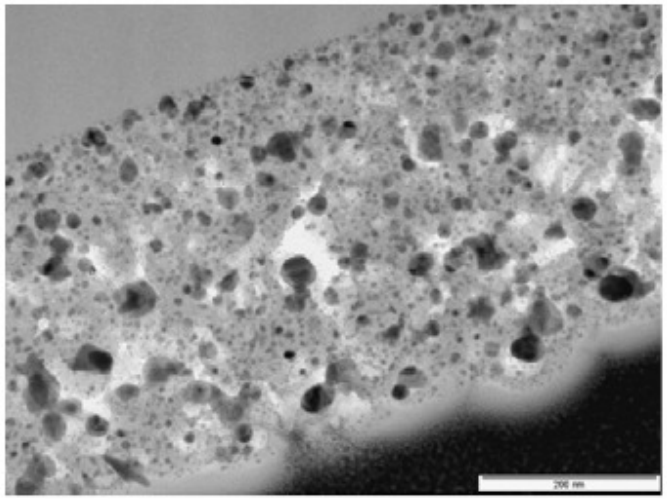
Pre-deposition pressure	70μPa
Working pressure	5.5 dPa
Power on silica target (6 inches)	200 W - RF
Power on silver target (1 inch)	1 W-DC

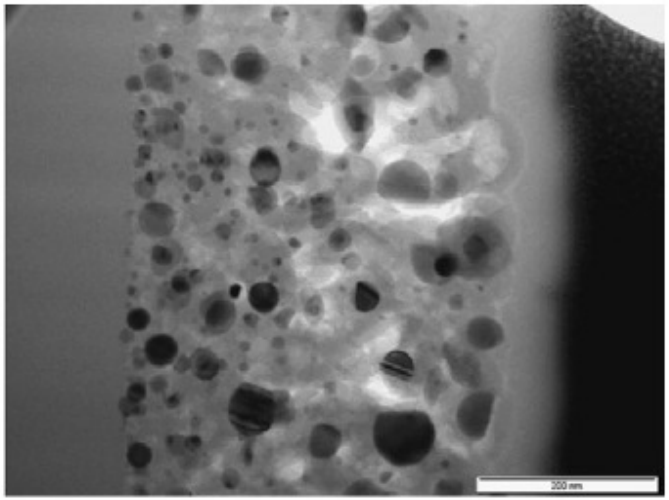
DEPOSITION TIME as a function of the substrate and its final application

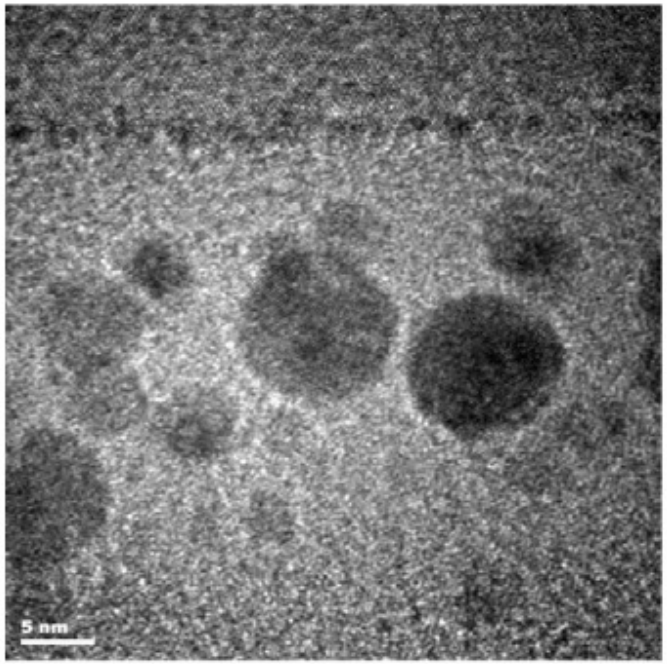


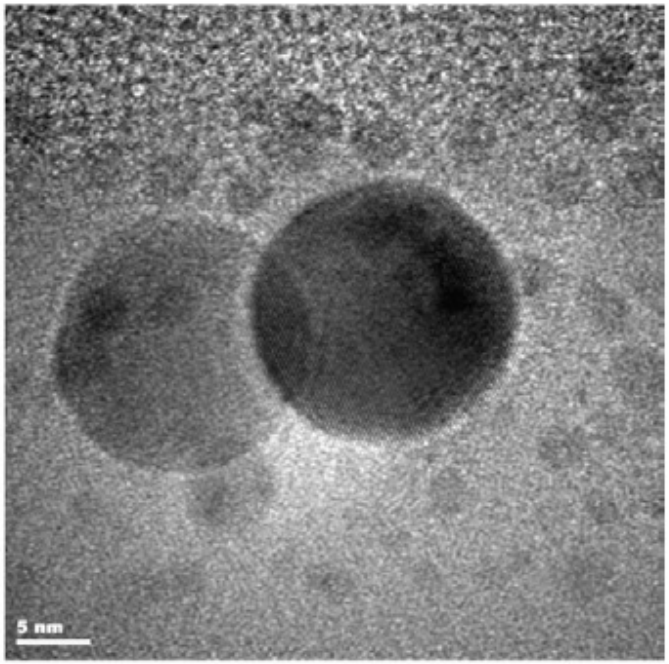
The idea, June 2007

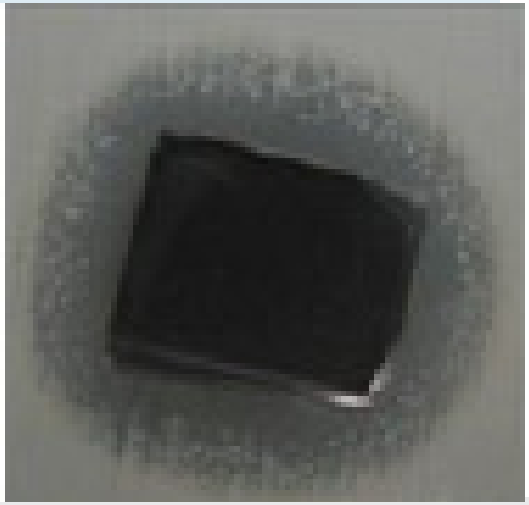
M. Ferraris et al. / Materials Chemistry and Physics 120 (2010) 123–126

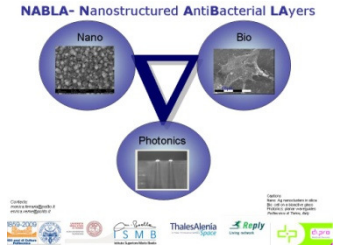




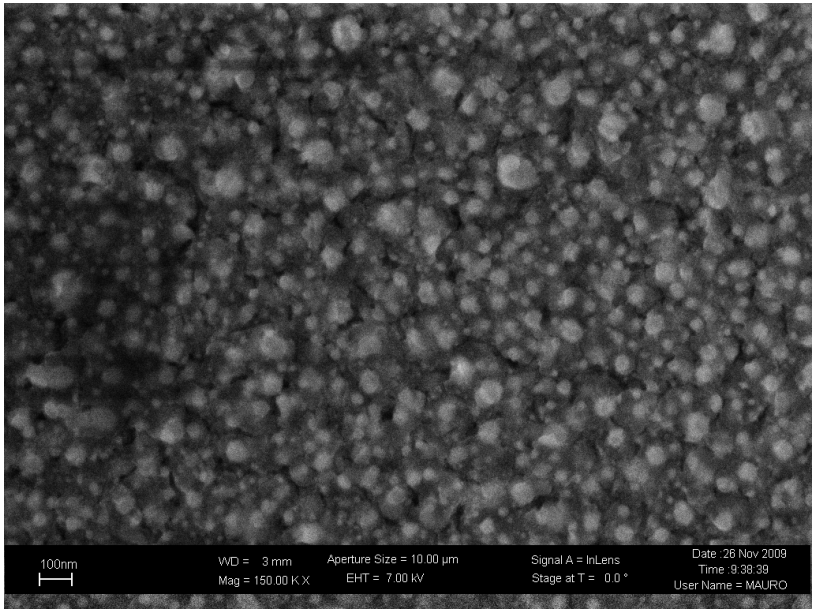




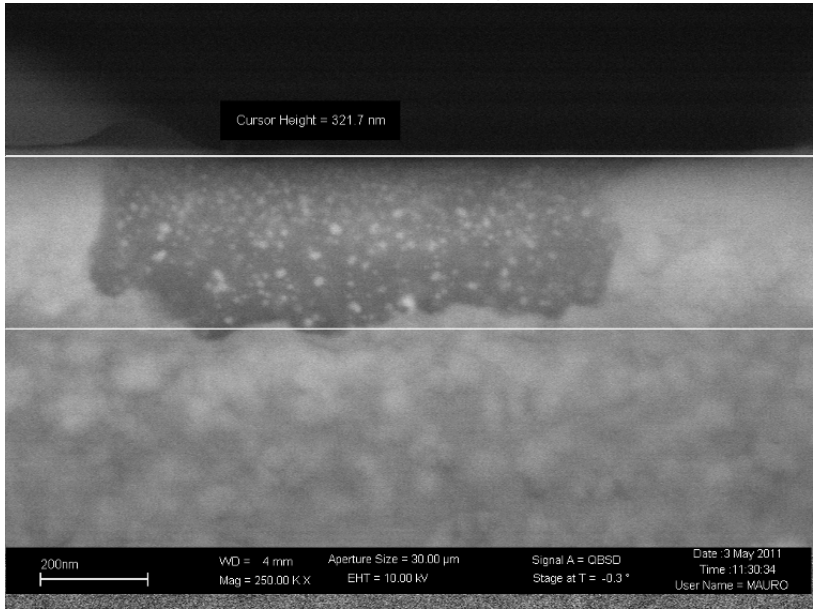


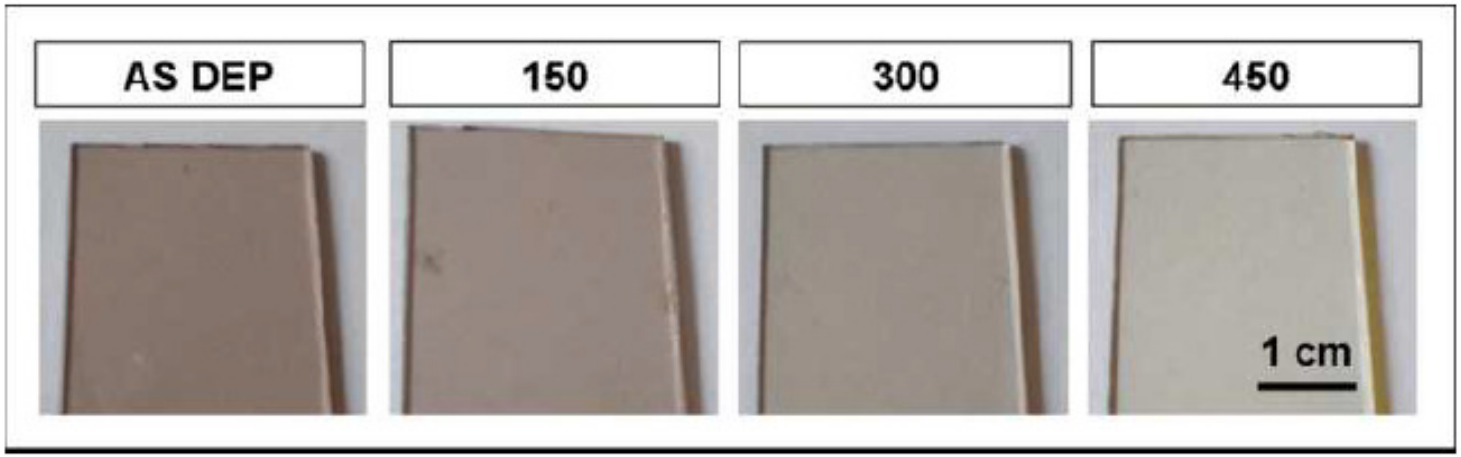


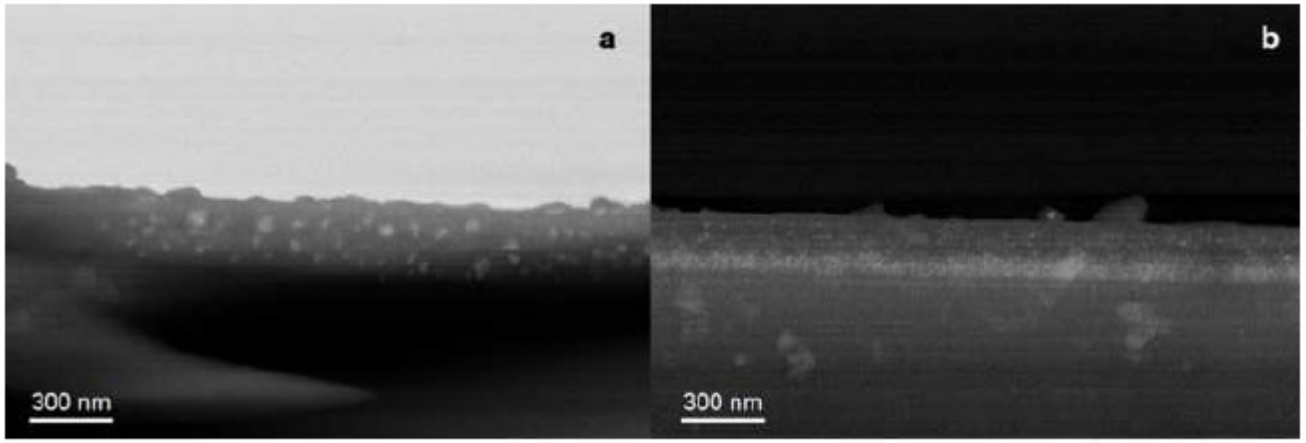
TOP VIEW (secondary electrons)



CROSS-SECTION (back-scattered electrons)

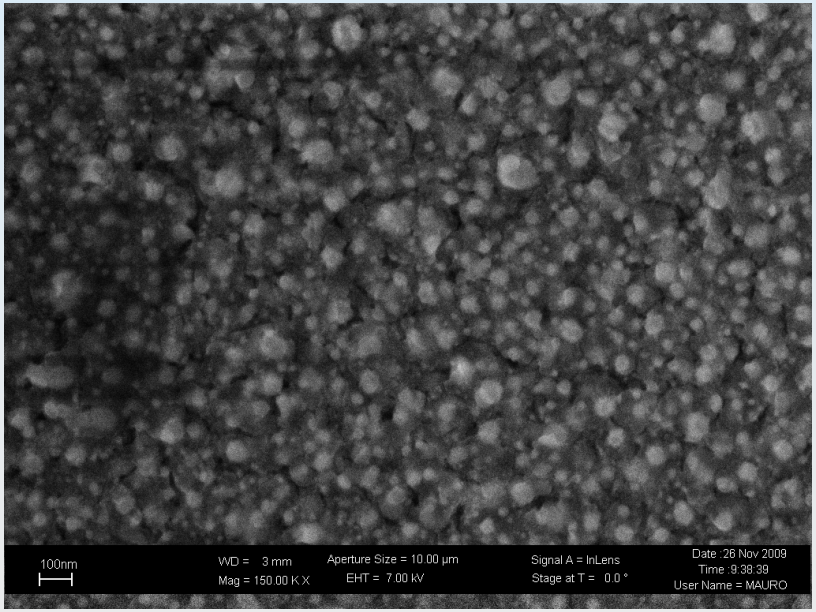



AS DEP
150
300
450
1 cm

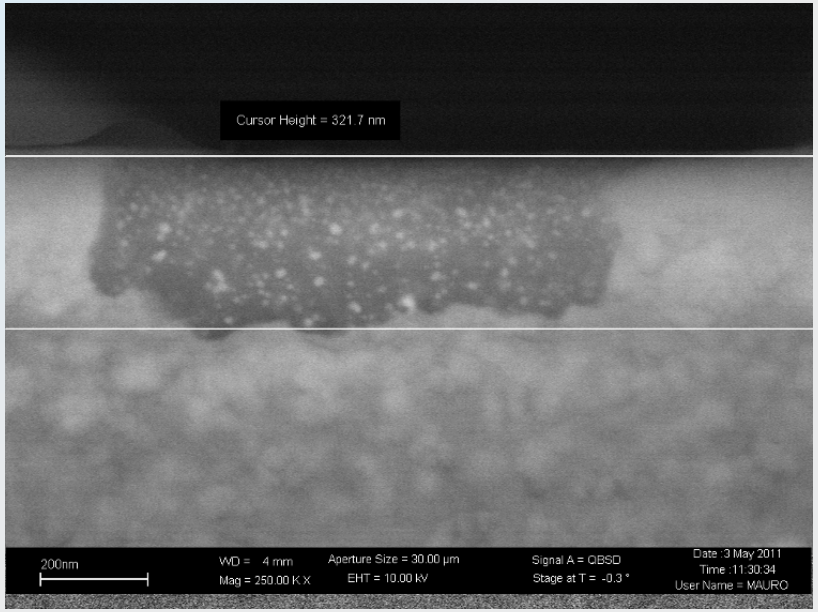

a
b
300 nm
300 nm

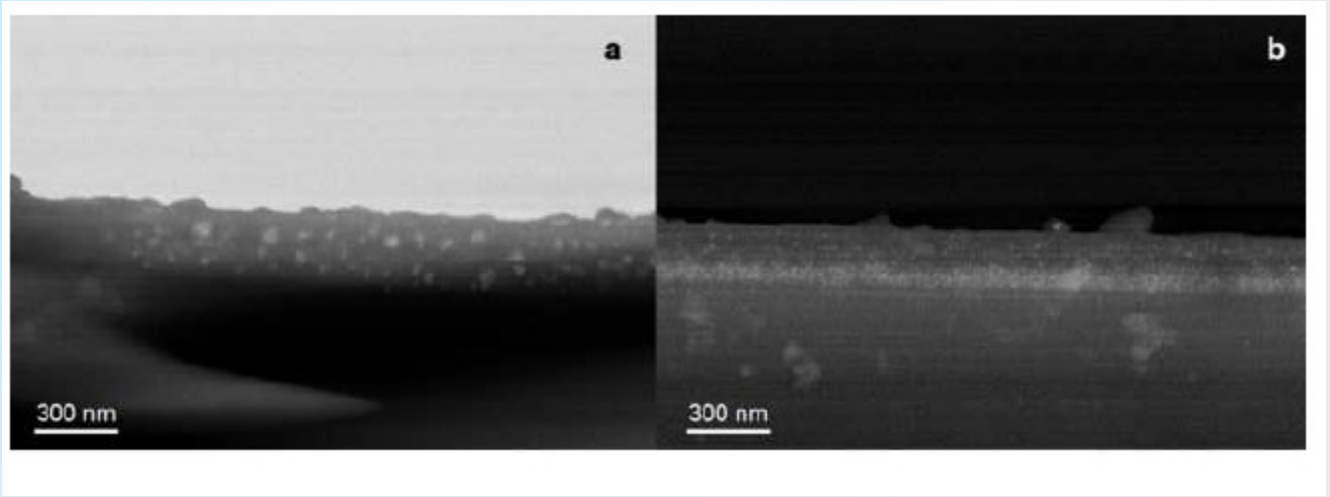
COATING CHARACTERIZATION:
Field Emission Scanning Electron Microscopy (FESEM)

TOP VIEW (secondary electrons)



CROSS-SECTION (back-scattered electrons)



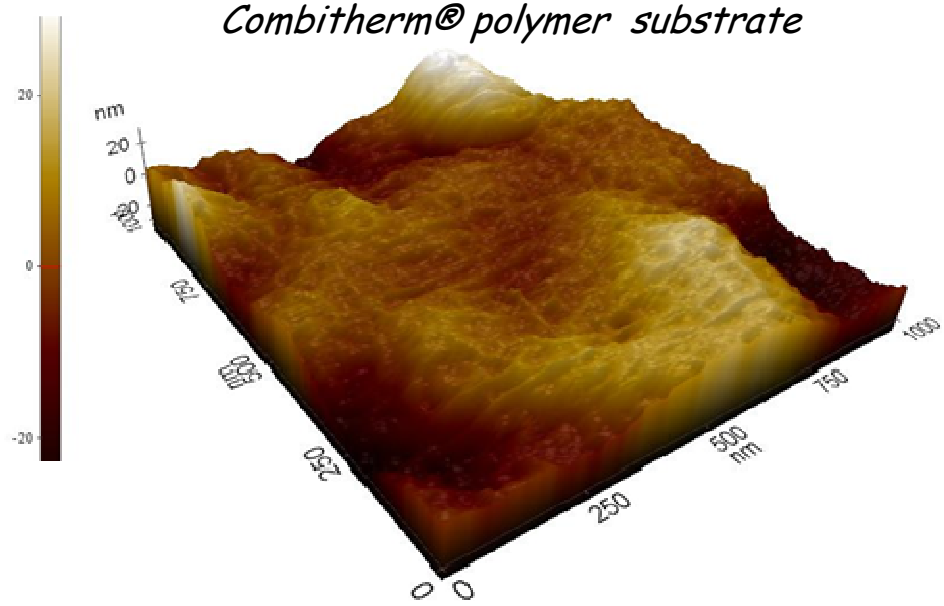


And MACROSCOPIC OBSERVATIONS

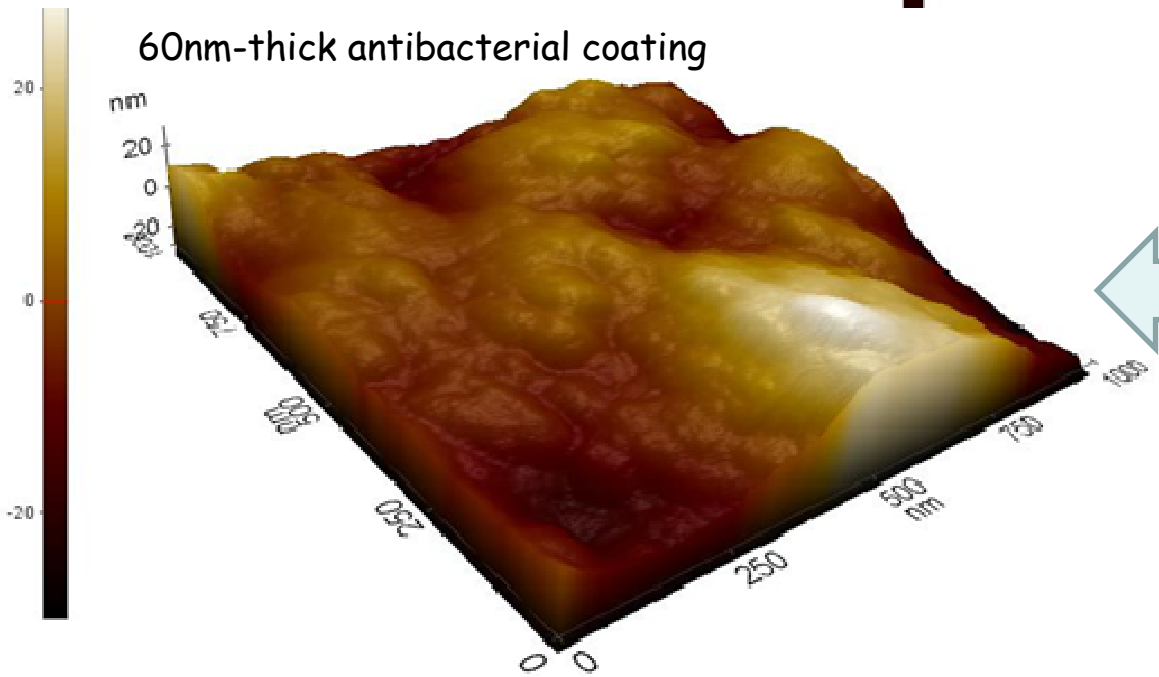
COATING CHARACTERIZATION:
Atomic Force Microscopy

Combitherm® polymer substrate

Honeycomb structure typical of polymers

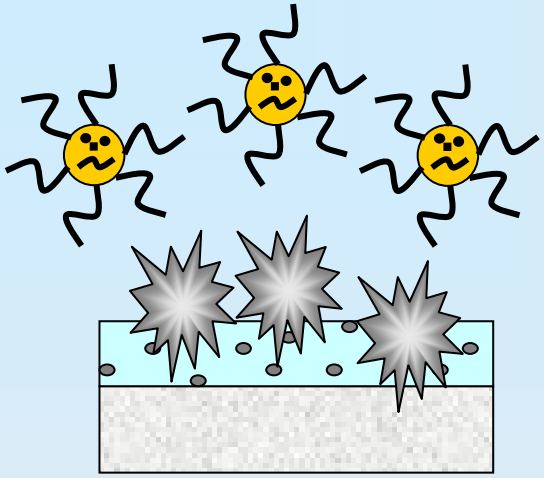


60nm-thick antibacterial coating

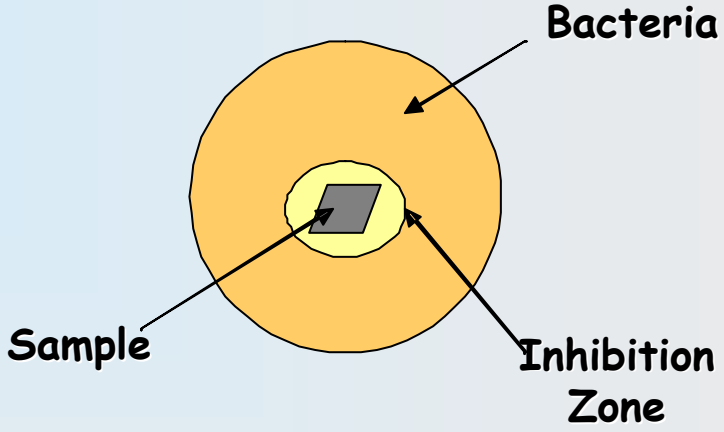


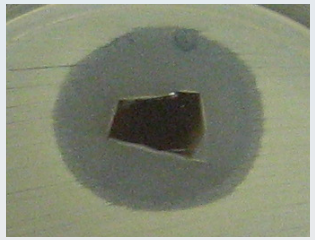
Nanostructured deposited coating (No honeycomb structure)

ANTIBACTERIAL ACTIVITY



INHIBITION HALO AGAINST S. AUREUS

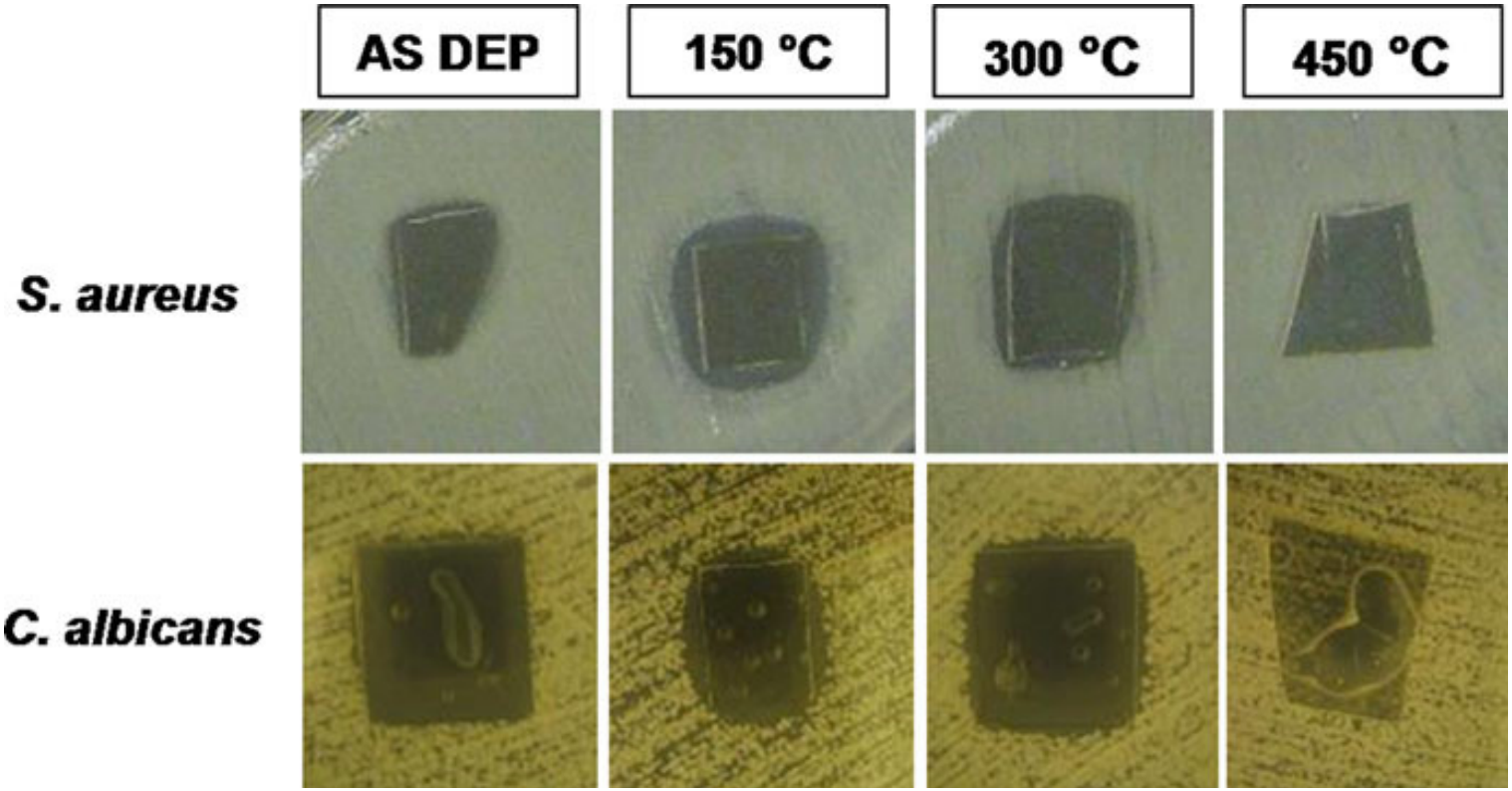




After Gamma sterilization

After EtO sterilization

Silver nanocluster/silica composite coatings on soda-lime glasses as deposited and after thermal treatments: inhibition halo for *S. aureus* and *C. albicans*



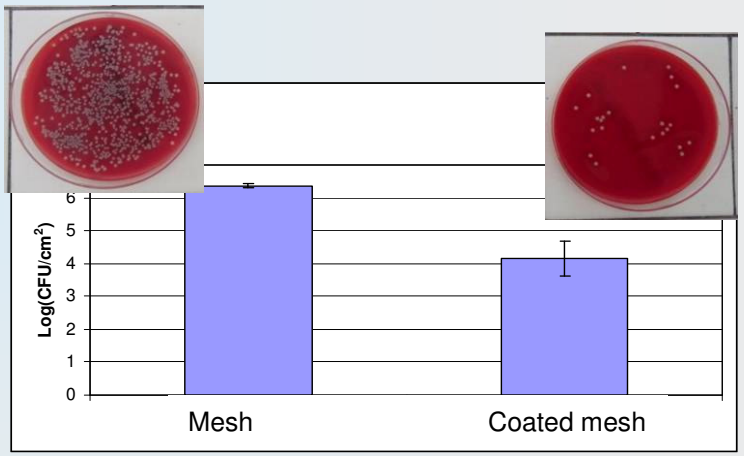
BIOMEDICAL APPLICATIONS

MAIN REQUIREMENTS

- Biocompatibility
- Good antibacterial behavior

Polymeric mesh for abdominal wall repair

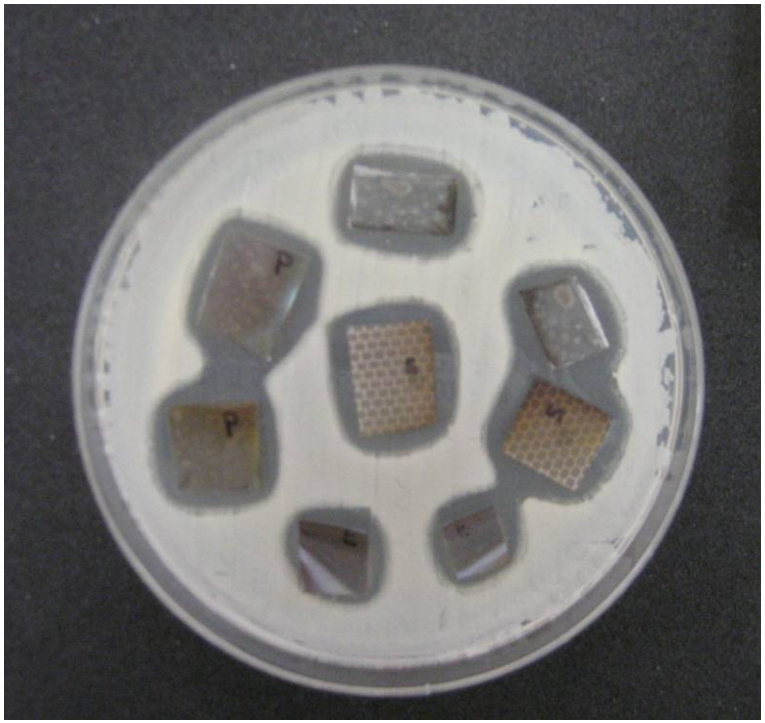
dipromed
Dipro Medical Devices

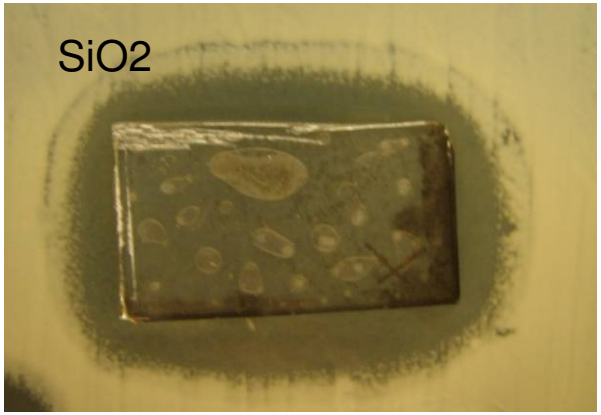


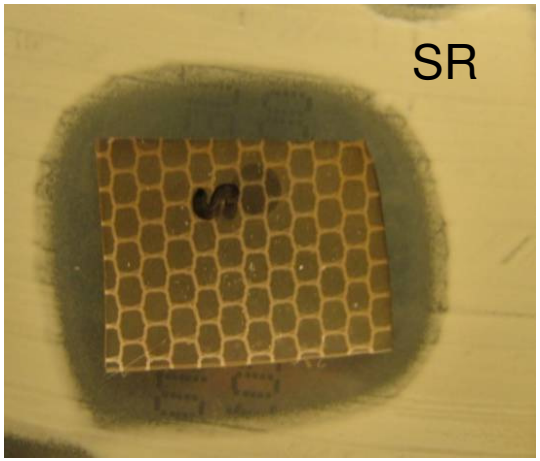
Properly optimizing process parameters it is possible to obtain antibacterial and biocompatible polymeric mesh.

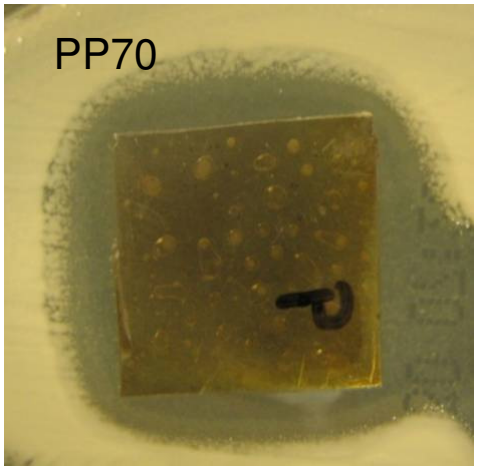
Antibacterial properties are maintained after washing and sterilization

BIOMEDICAL APPLICATIONS





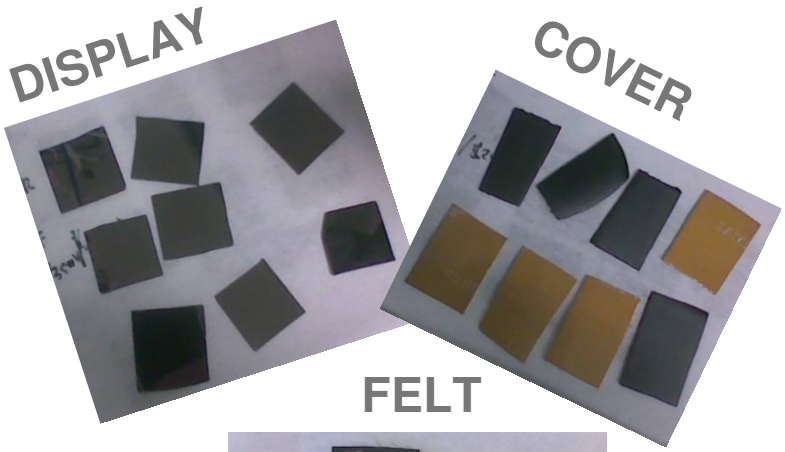




EVERYDAY LIFE APPLICATIONS: MOBILE TELEPHONES

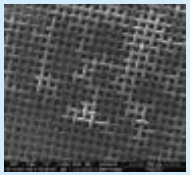
SPUTTERING DEL TELEFONO COMPLETO

SPUTTERING DELLE COMPONENTI

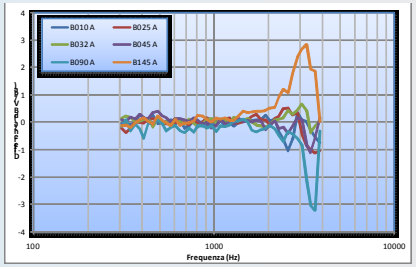


FELT

Acoustic Felt

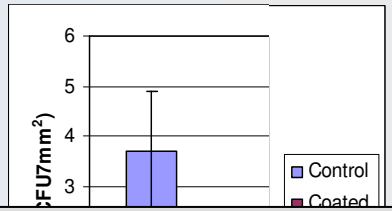


- Antibacterial
- Acoustic properties



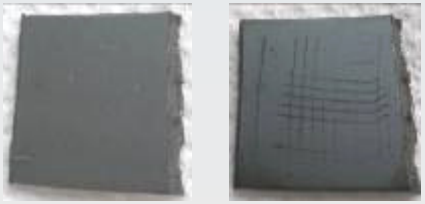
Screen

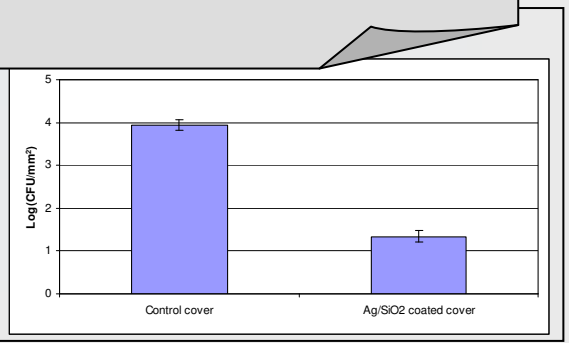
- Aesthetical/Transparency



Properly optimizing process parameters to match the requirements of different parts and to obtain an antibacterial cell phone

- Aesthetical
- Antibacterial
- Good adhesion

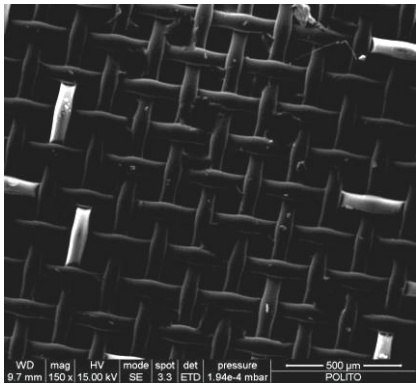




Reply
Living network

FELT: diverse tipologie considerate

B010



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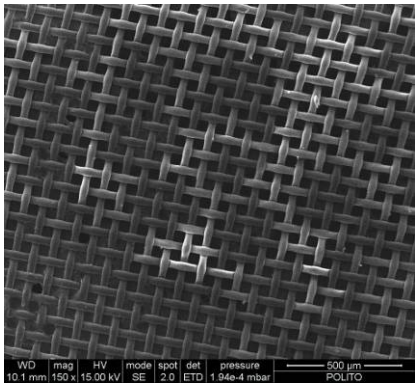

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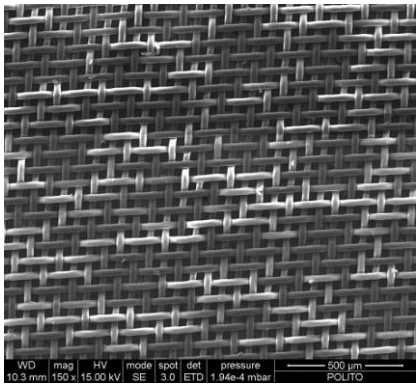

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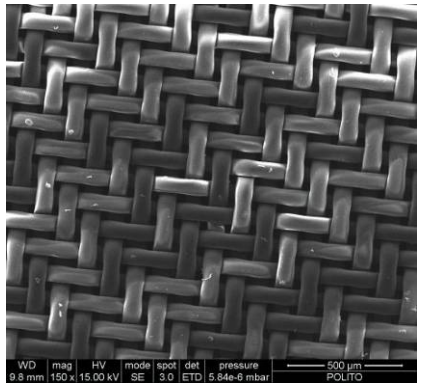

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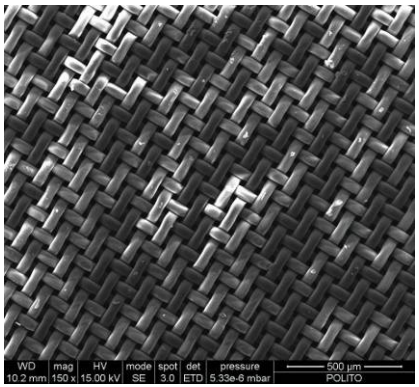

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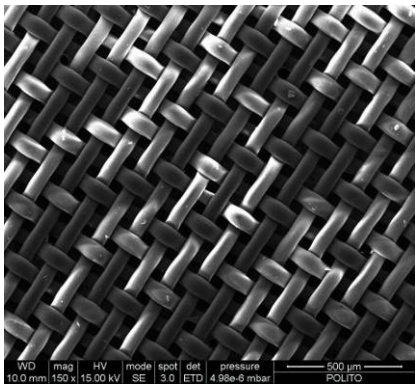
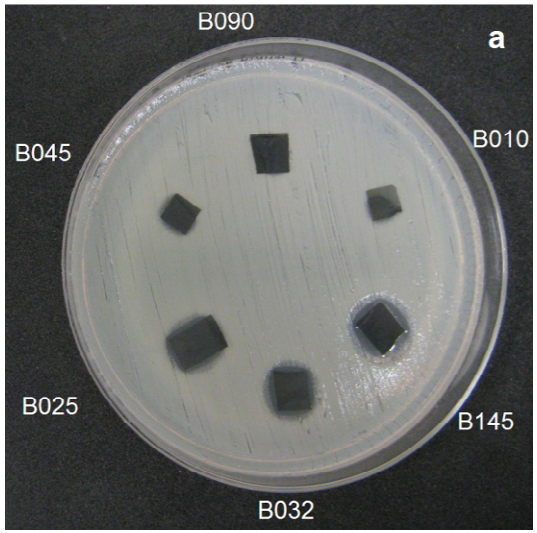


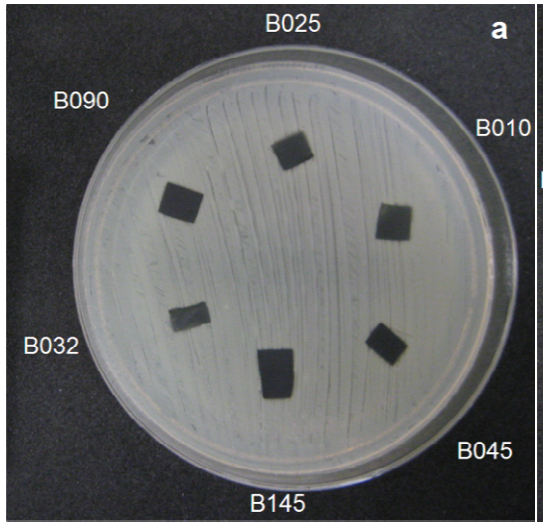
FELT:VALUTAZIONE DELLE PROPRIETA' ANTIBATTERICHE

ALONE DI INIBIZIONE

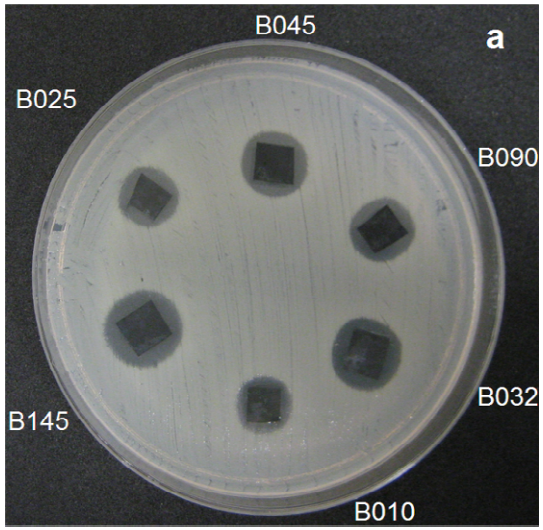
COND 2



COND 3



COND 4



PERSONNEL PROTECTIVE SYSTEMS APPLICATIONS

MAIN REQUIREMENTS

- Mechanical Properties
- Permeability
- Washebility
- Antibacterial activity
- Skin con

CURRENT ACTIVITY

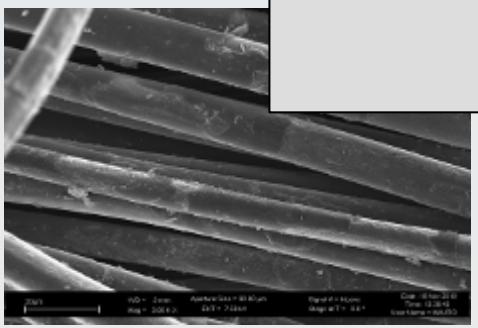
Nylon,

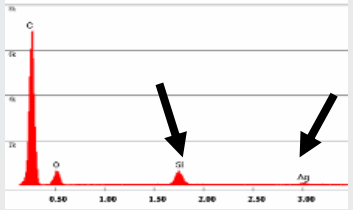
AEROSEKUR SAFETYFIRST

Mimetic tissue for personnel protective equipments

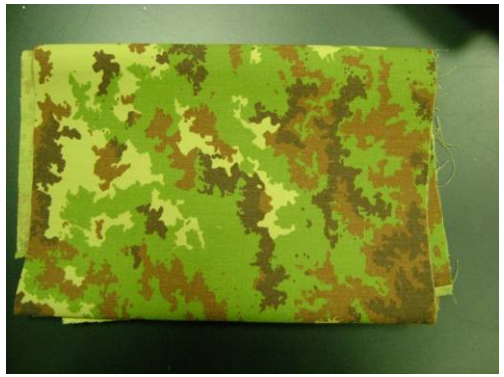
Properly optimizing process parameters it is possible to:

- ✓Tailor antibacterial activity
- ✓Maintains substrate mechanical and permeability characteristics

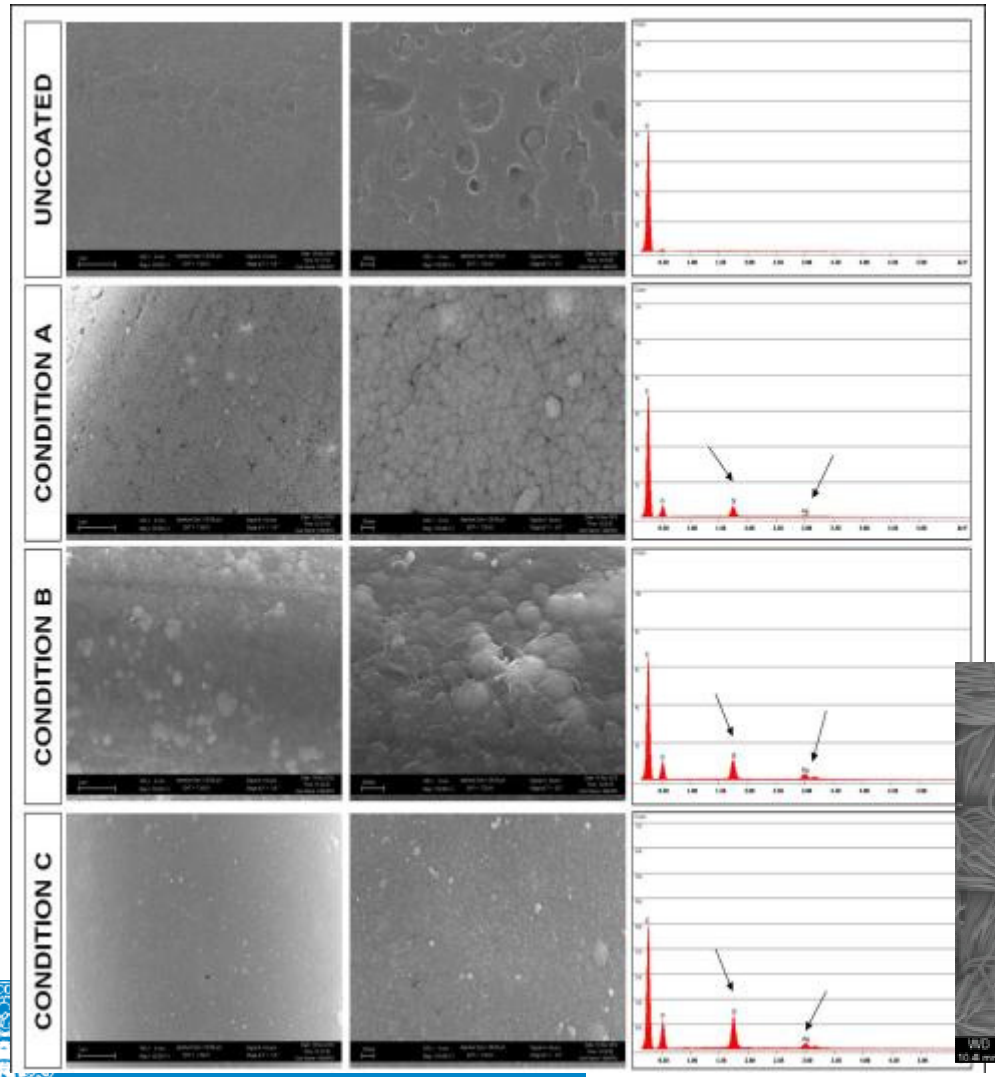




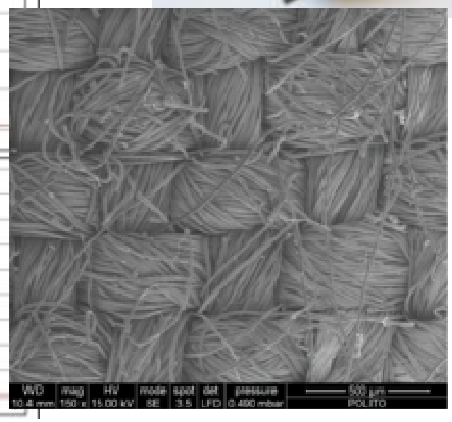
- *KEVLAR AND ACTIVATED CARBON FABRIC FOR PERSONAL PROTECTION FIELDS*
- *NYLON FABRIC FOR SPACE PARACHUTE*

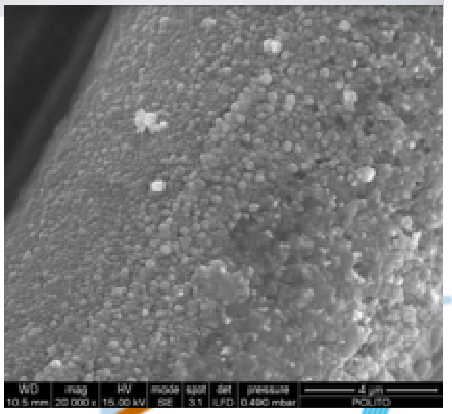


NASLA coated antiseptic textiles for Personal Protection Systems



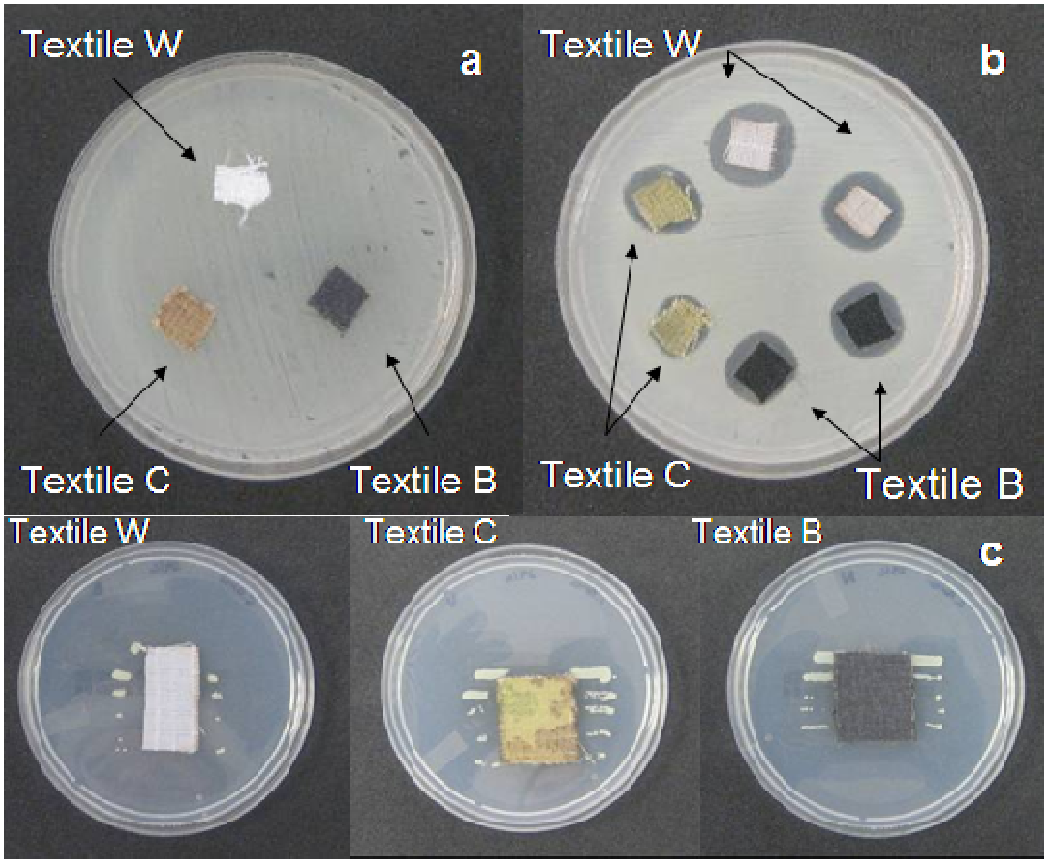
AERO SEKUR





NASLA coated antiseptic textiles for Personal Protection Systems

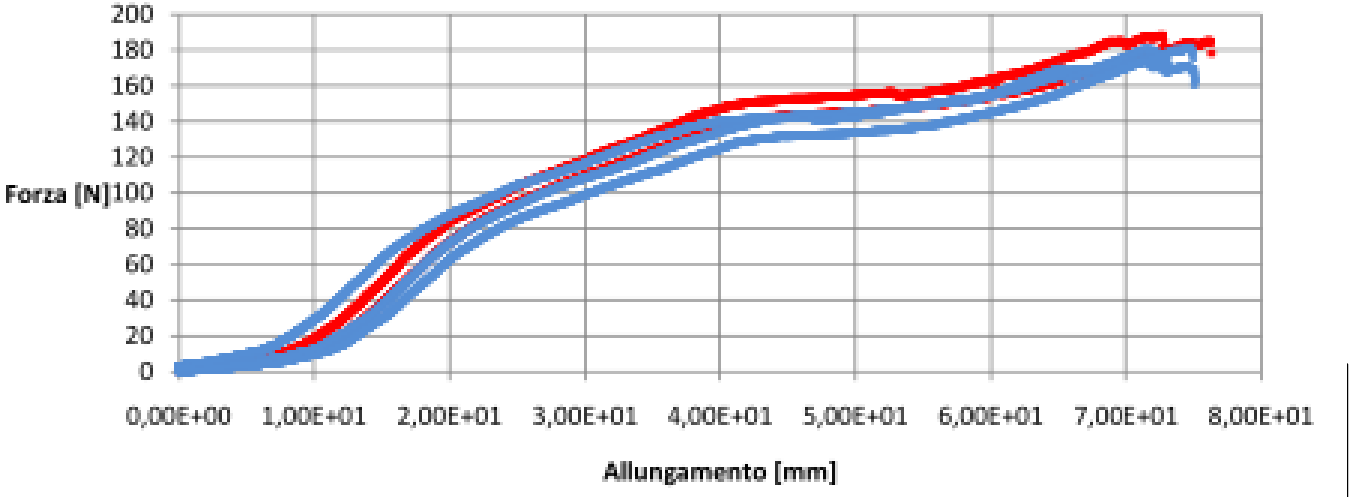
- inhibition zone for uncoated and NASLA coated textiles: inhibition halo and parallel streak method (AATCC 147)

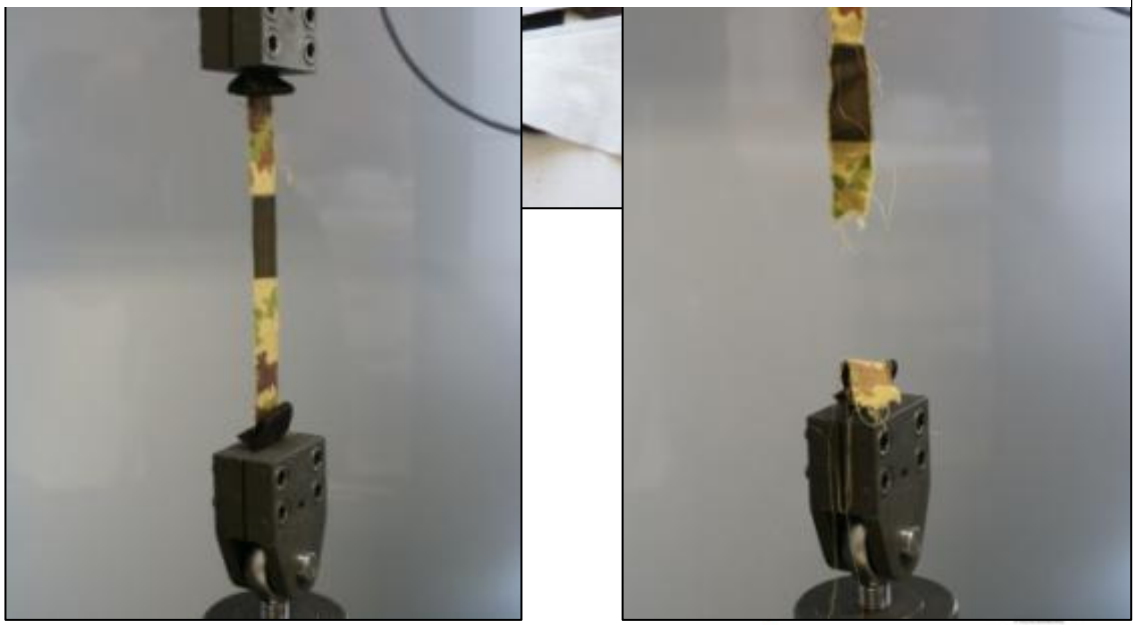


POLITECNICO DI TORINO

NASLA coated antiseptic textiles for Personal Protection Systems

- Aero Sekur:
- Mechanical tests before and after NASLA layer



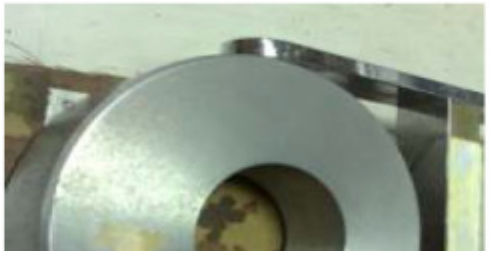


POLITECNICO DI TORINO

NASLA coated antiseptic textiles for Personal Protection Systems

- Aero Sekur:
- Permeability, wettability and resistance to flame before and after NASLA layer

AERO SEKUR *Report di Laboratorio*
N° 40813 Data 19/10/2011

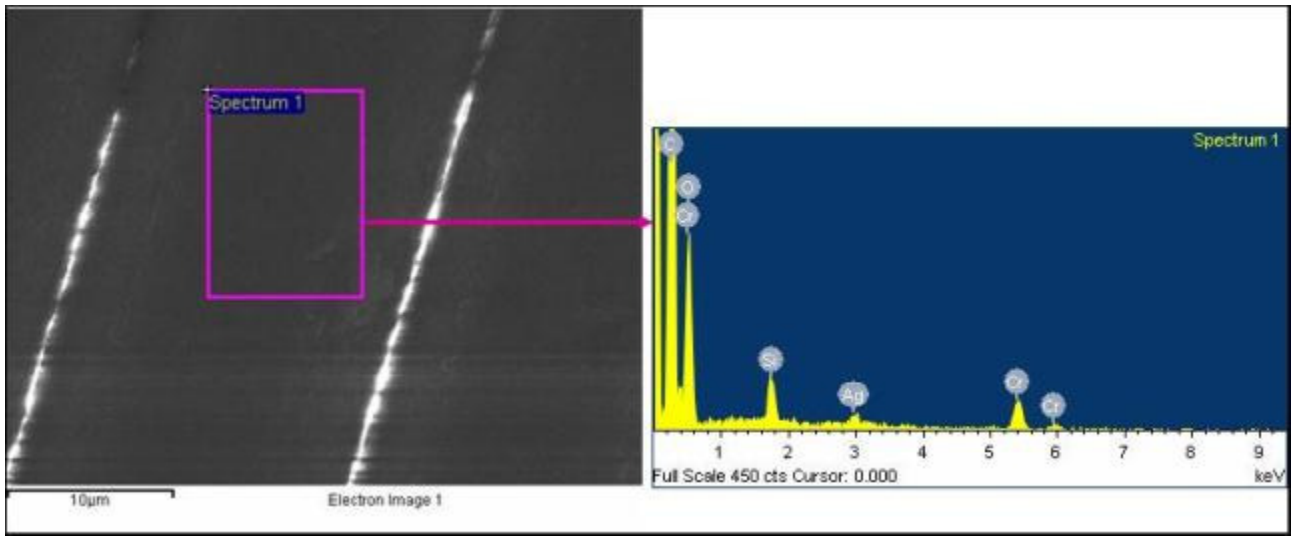


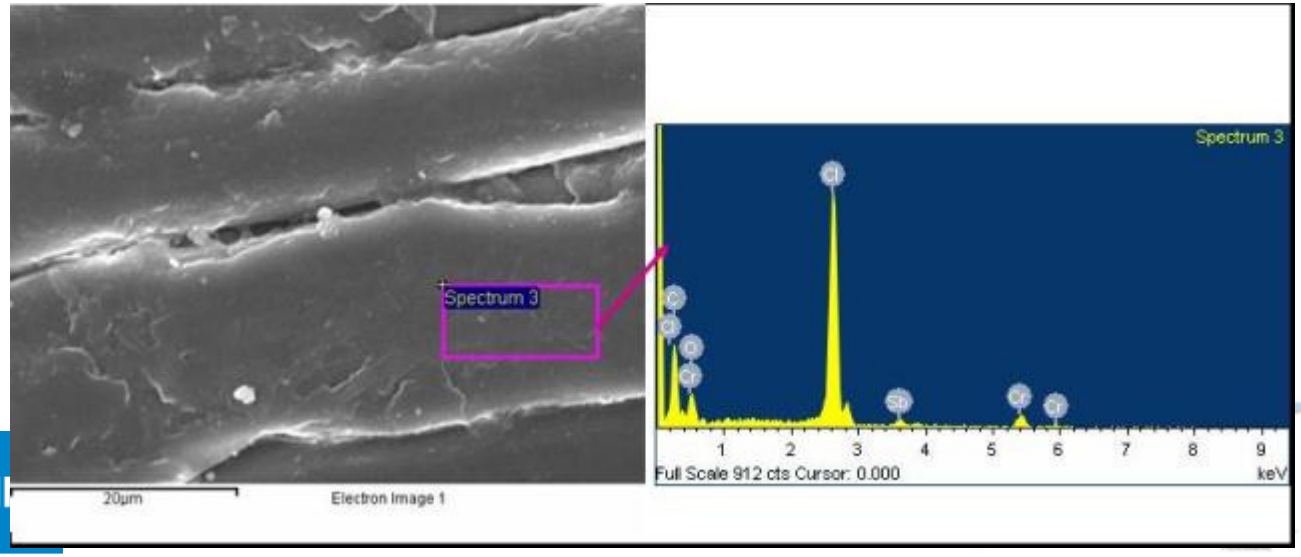
AERO SEKUR *Report di Laboratorio*
N° 40813 Data 19/10/2011

POLITECNICO DI TORINO

NASLA coated antiseptic textiles for Personal Protection Systems

- FESEM and EDS analyses on Textile W (a) and on Textile C (b) after Aerosekur water repellency and permeability tests





- *TENSILE STRENGHT - **PASSED***
- *FLAMMABILITY - **PASSED***
- *PERMEABILITY - **PASSED***
- *WATER REPELLENCY - **PASSED***

As per UNI-ISO and ASTM standards

ALL TREATED SAMPLES MAINTAIN THEIR ANTISEPTICAL FEATURES AFTER TESTS

AEROSEKUR

AEROSPACE APPLICATIONS

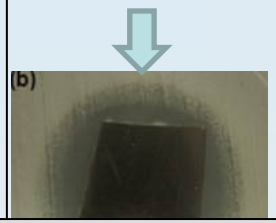
CURRENT ACTIVITY

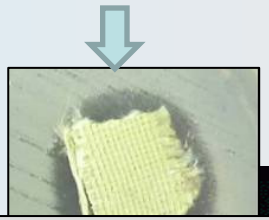
Inflactable modulus

ThalesAlenia Space
A Thales / Finmeccanica Company

MAIN REQUIREMENTS

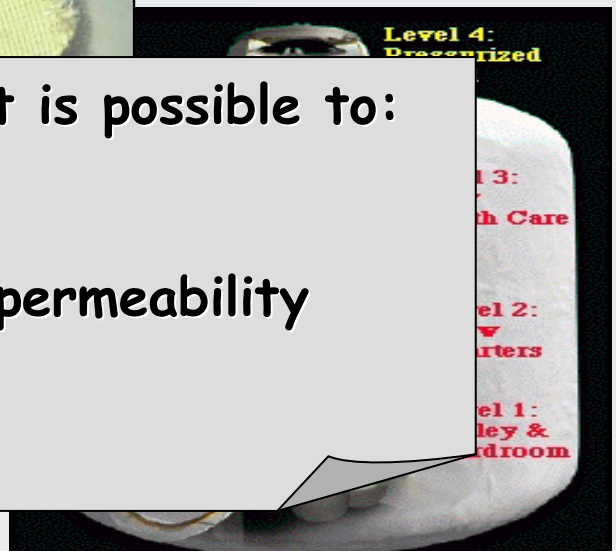
- Mechanical properties
- Good adhesion
- Very Low Gas Permeability
- Anti



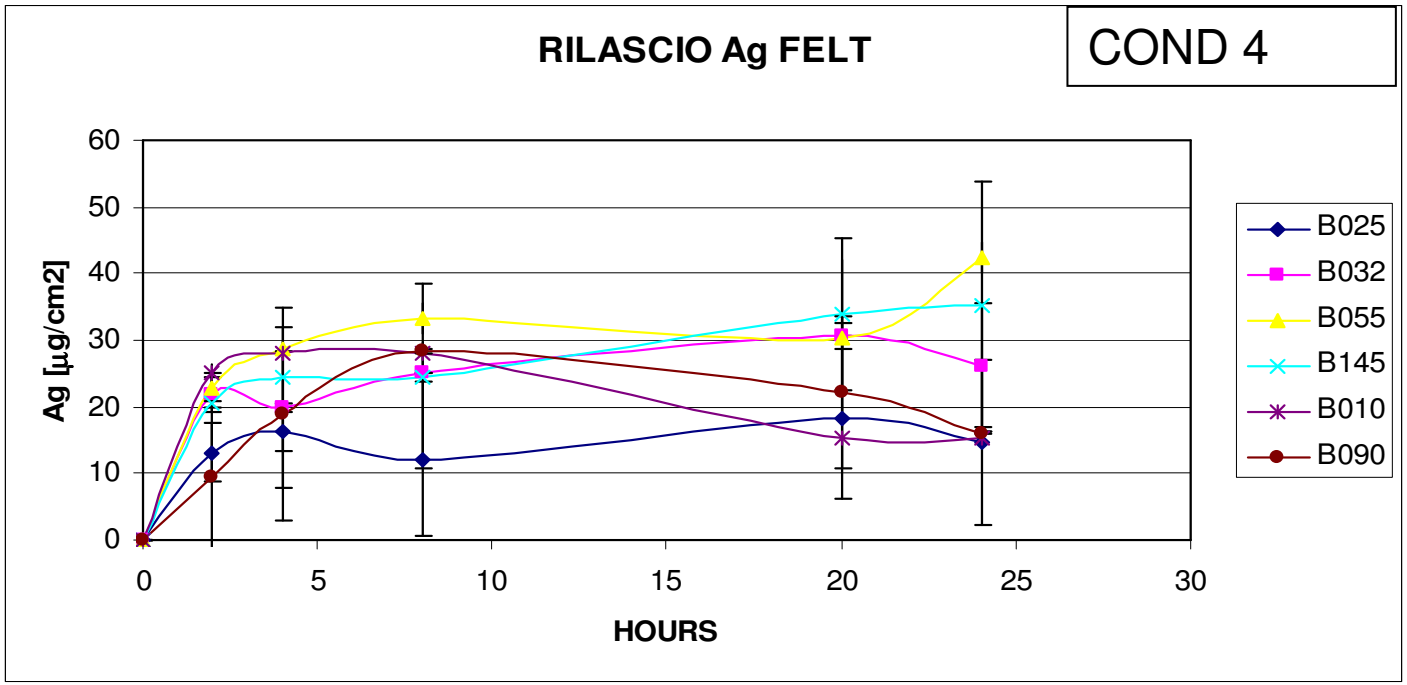


Properly optimizing process parameters it is possible to:

- ✓Tailor antibacterial activity
- ✓Maintain substrate mechanical and permeability characteristics



FELT:VALUTAZIONE DEL RILASCIO DI Ag IN SUDORE SINTETICO *



Gran parte dell'Ag viene rilasciato nelle prime ore, proporzionale alla condizione di deposizione)

** Analisi assorbimento atomico presso il laboratori del Dipartimenti di Traumatologia, Ortopedia e Medicina del Lavoro*

Conclusioni

- *Deposizione tramite sputtering di rivestimenti antibatterici compositi a base di silice e argento*
- Resistenti a T di circa 400 °C
- *Dimostrata la fattibilità su tessuti per applicazioni biomediche, aerospaziali, protezione individuale, felt per telefoni cellulari,….*
- ….altre idee?

Un ringraziamento particolare ai colleghi :

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Marta Miola,
Sergio Perero,
Enrica Vernè

Grazie a tutti voi per l'attenzione !

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