

Willkommen
Welcome
Bienvenue



Projektvorschlag "non-leaching antimicrobials"

Nano Initiative des Bundesministeriums für Verkehr, Innovation und Technologie
Workshop "Potenziale der Nanotechnologie für Unternehmen"

Dr. Dirk Hegemann (Empa)/ Dr. Gaffar Hossain (V-trion)

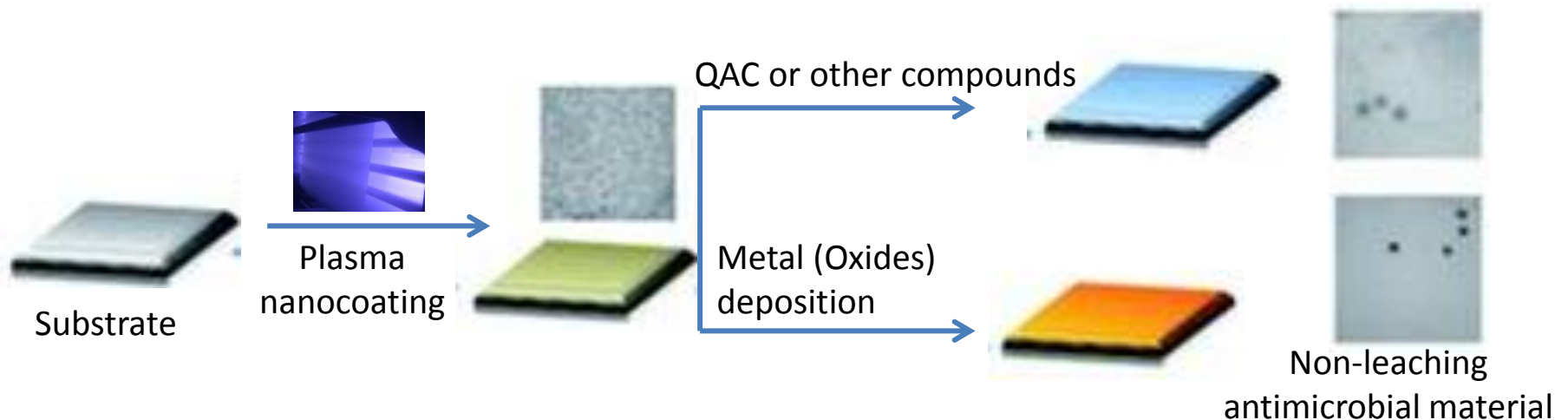
Non-leaching antimicrobials

Goal: To produce non-leaching antimicrobial material through plasma (assisted) nanocoating of antimicrobial substances or catalytically active surfaces

Non-leaching antimicrobials

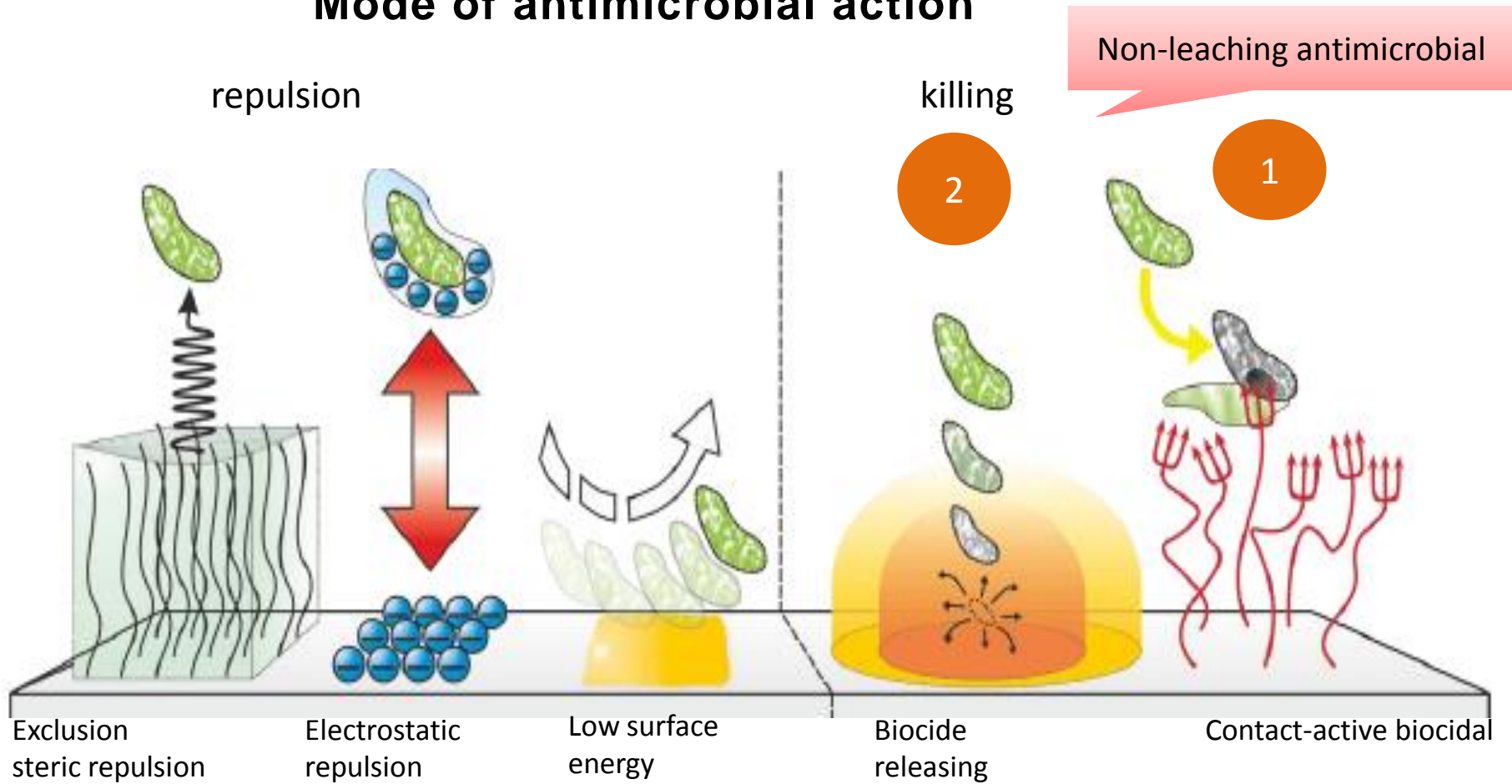
Approaches

- 1) Antimicrobial substances (e.g, quaternary ammonium salts or others) will be linked covalently to the plasma nanocoated surface.
- 2) Generation of metal (oxides) island (with dissimilar metals) over the catalytically active surfaces



Non-leaching antimicrobials

Mode of antimicrobial action

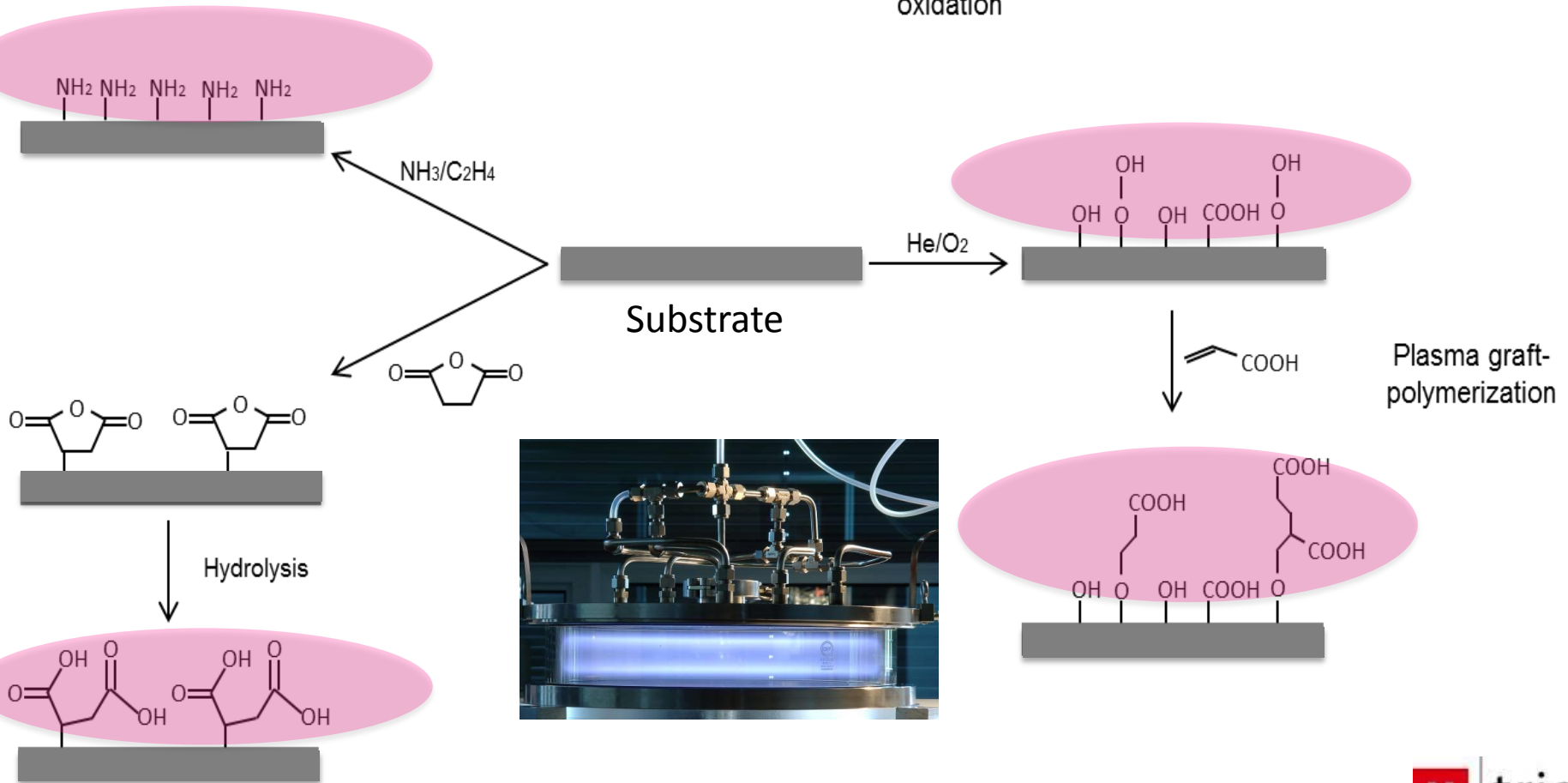


Immobilization of antibacterial compounds

Grafting onto functionalized surfaces

Control plasma
functionalization

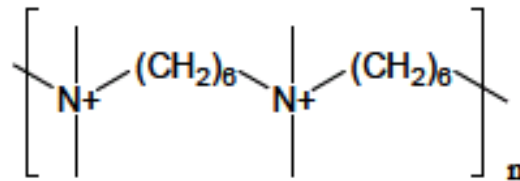
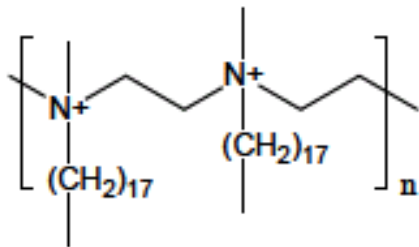
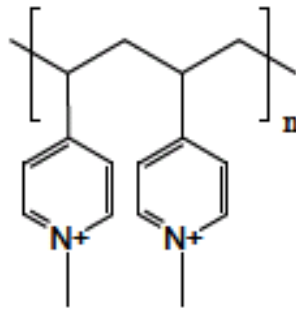
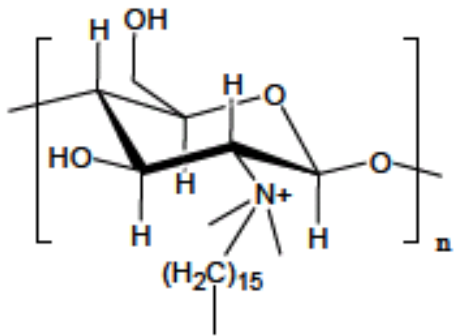
Etching plasma
+ Post-plasma
oxidation



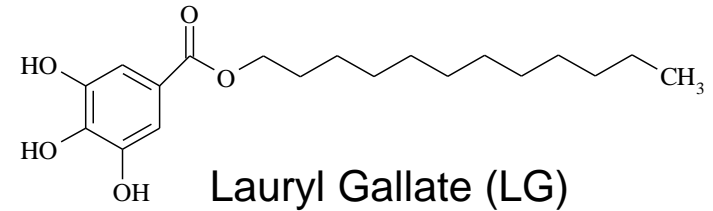
Immobilization of antibacterial compounds

Grafting onto functionalized surfaces

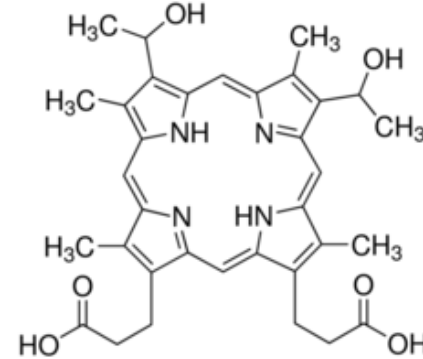
Antimicrobial compounds



➤ Biocidal polymers with quaternary ammonium groups



➤ Multifunctional (antimicrobial/ antioxidant/ hydrophobe) Gallate compounds



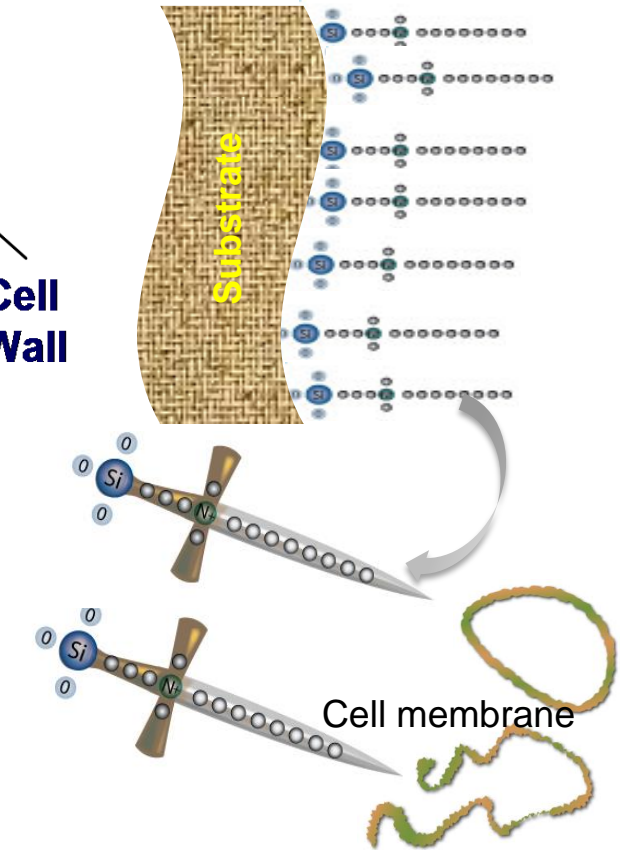
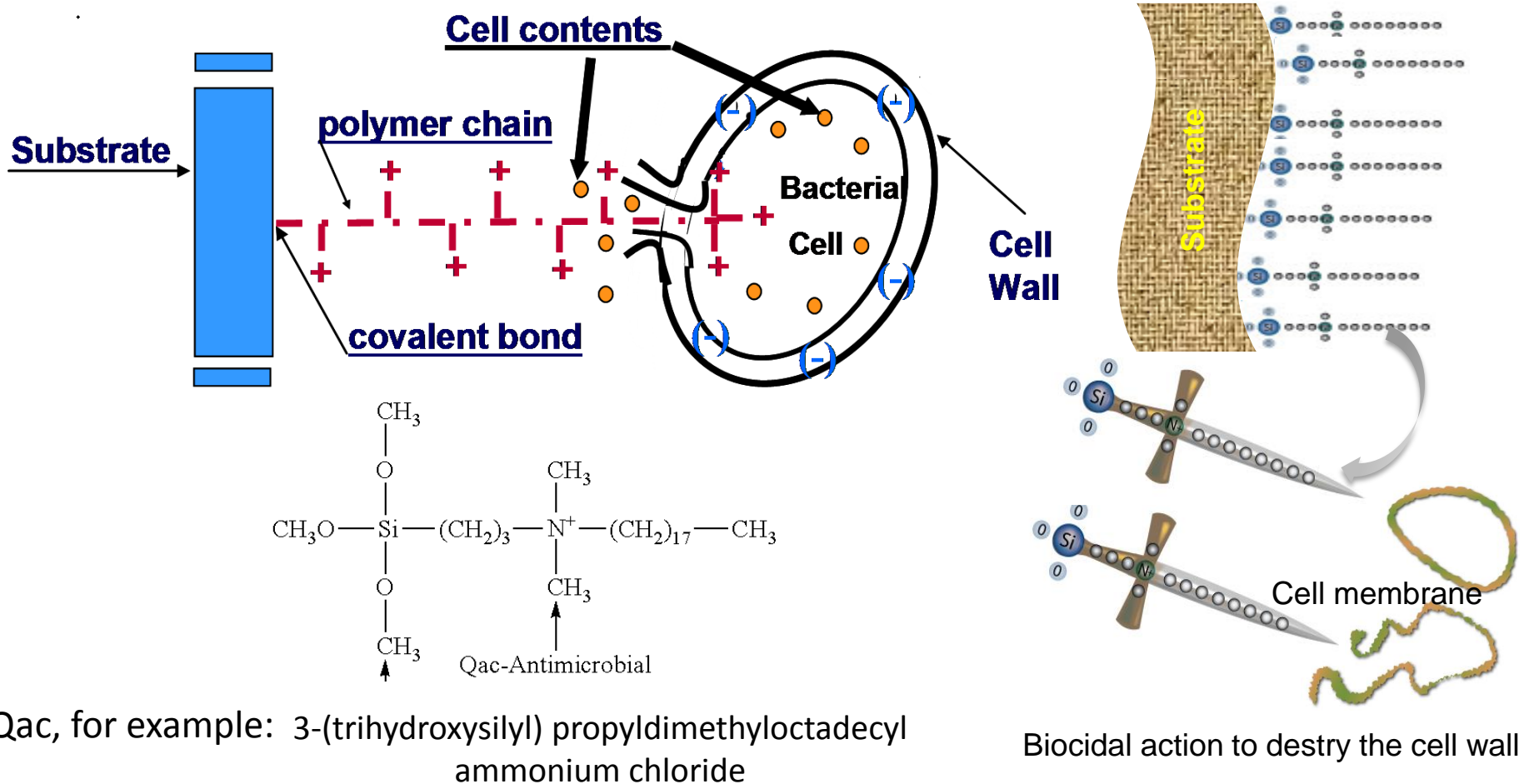
➤ Hematoporphyrin (Photoinduced antimicrobial)

- Aminolevulinic acid
- Photofrin
- Enzyme etc

Immobilization of antibacterial compounds

Grafting onto functionalized surfaces

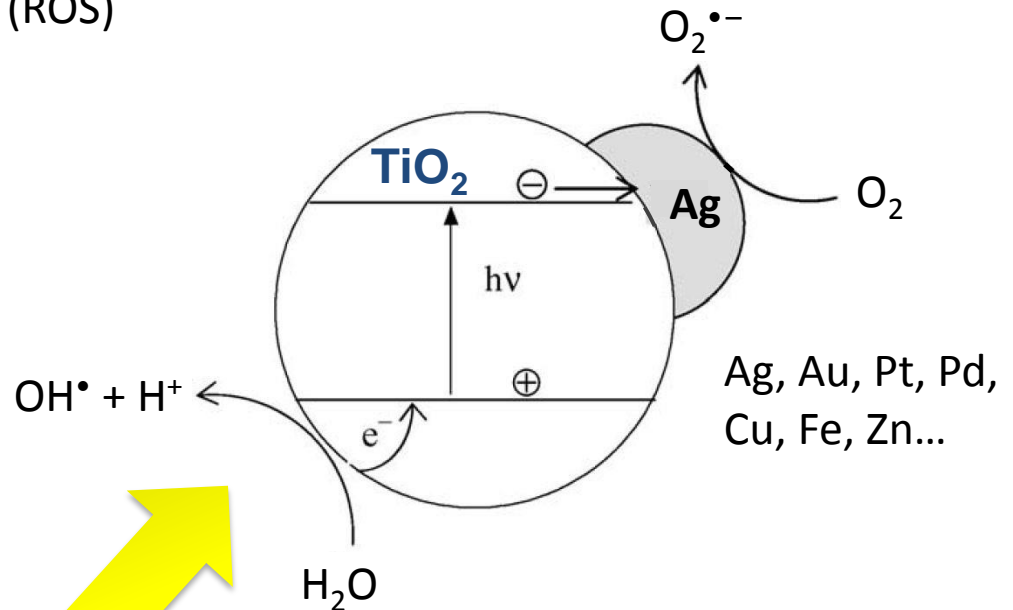
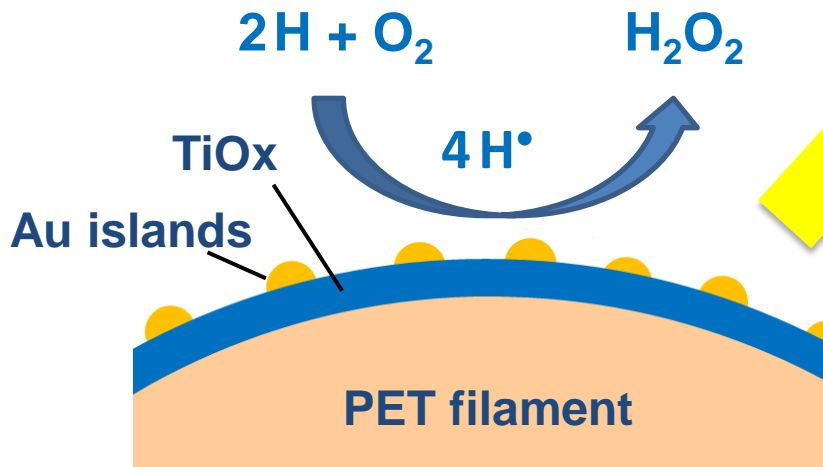
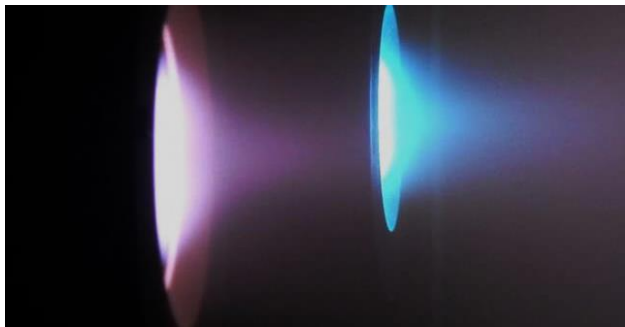
e.g. grafting of quaternary ammonium compounds (Qac) onto functionalized surfaces



Catalytically active surfaces

Deposition of dissimilar metals (metal oxides)

Generation of reactive oxygen species (ROS)

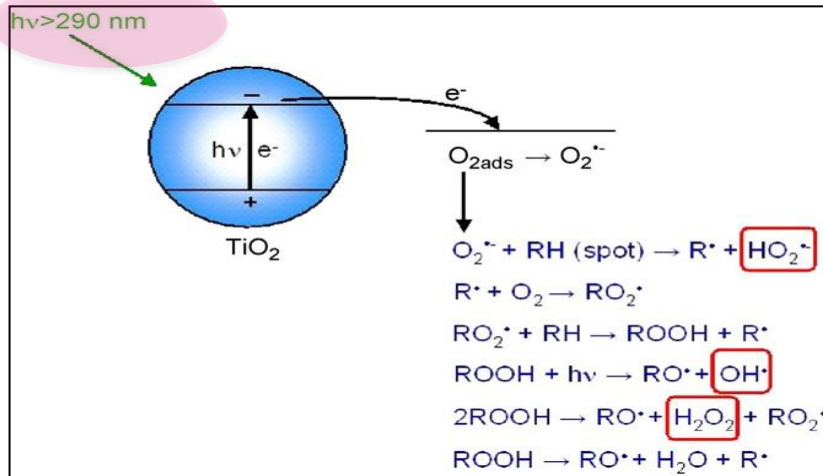


→ formation of ROS
($\text{O}_2^{\bullet-}$, OH^{\bullet} , HO_2 , H_2O_2 etc.)

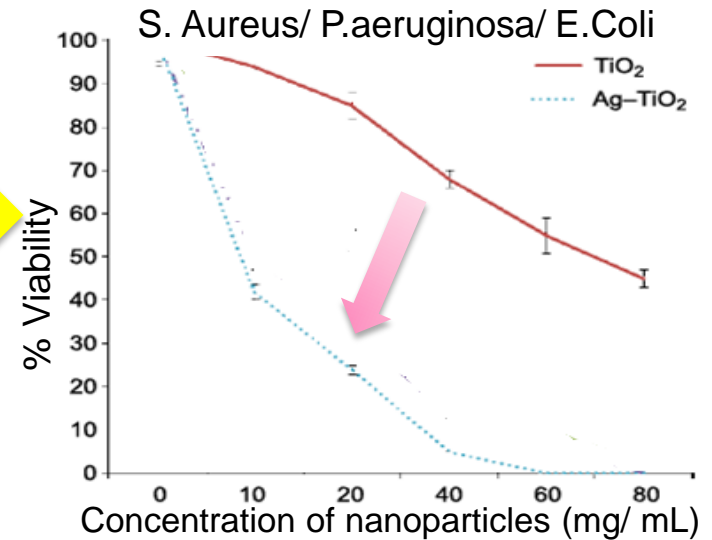
→ antibacterial effect on respiratory
system of bacteria

Catalytically active self-cleaning and antimicrobial surfaces

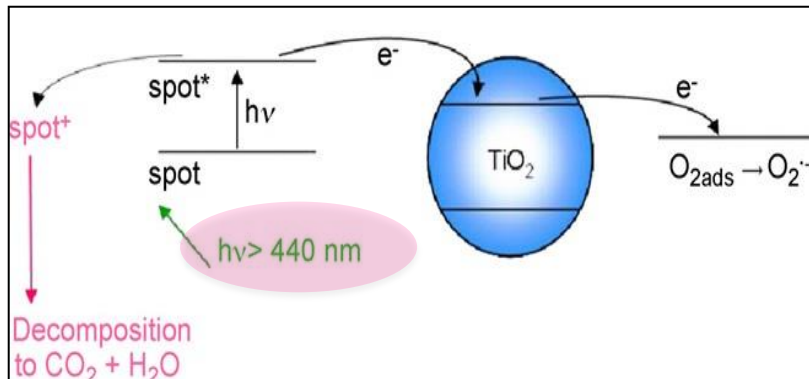
ROS formation at $h\nu > 290$ nm



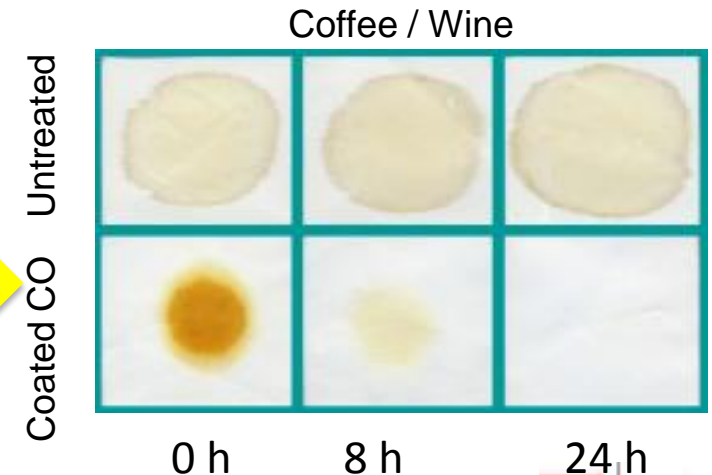
Antimicrobial



Stain decomposition mechanism at $h\nu > 440$ nm



Self-cleaning



Catalytically active self-cleaning and antimicrobial surfaces

