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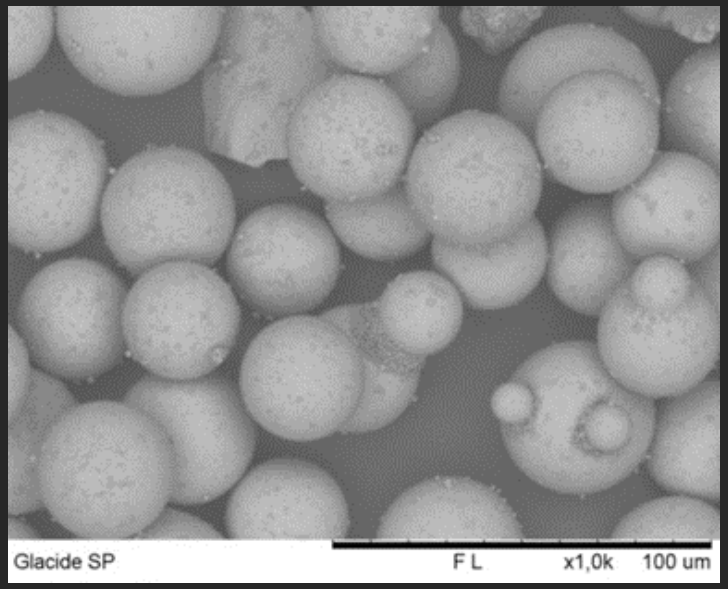
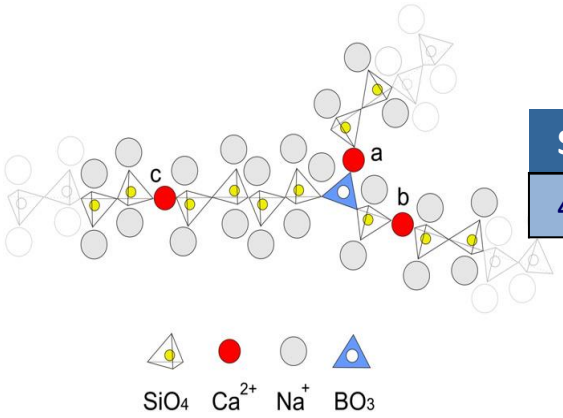
G3®

BIOGLASS



PATENTED METAL FREE, BROAD-SPECTRUM ANTIMICROBIAL MATERIAL

PRODUCT DESCRIPTION



Chemical Composition (wt%)

SiO_2	B_2O_3	Na_2O	CaO	P_2O_5	K_2O	MgO	Al_2O_3	Fe_2O_3	Others
40.3	8.5	18.8	19.2	-	0.57	-	11.7	0.12	0.81

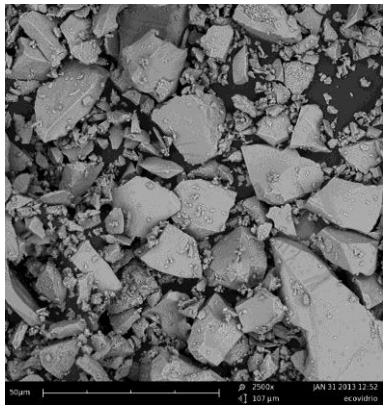
Glass particle size: d< 50 µm (D_{50}: 13 µm; D_{90}: 36 µm)

Specific surface area (S_{BET}): 0.95 m^2/g

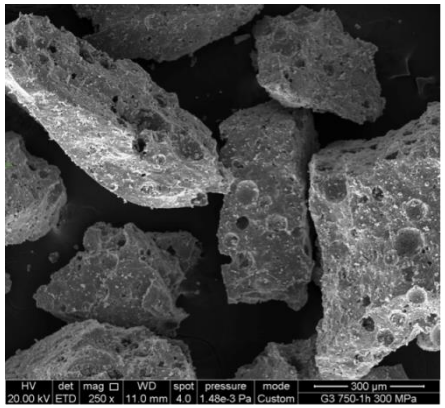
Real density (ρ_{real}): 2.55 g/cm^3

Different architectures, such as dense particles produced by conventional melting and casting, and porous structures obtained by foam replication method. This track record of performance has created a rich set of opportunities.

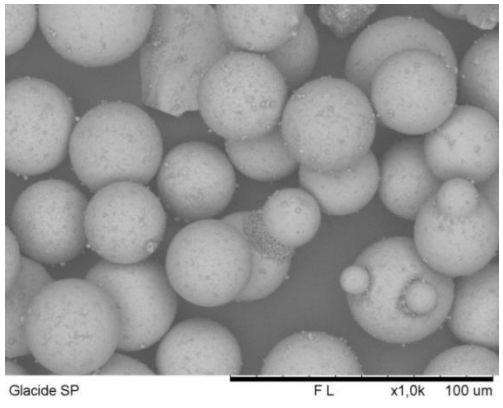
Dense Granules



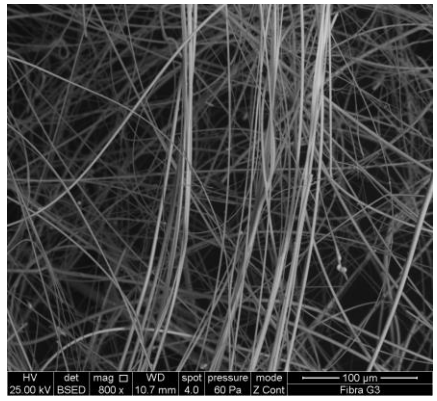
Porous Granules



Microspheres

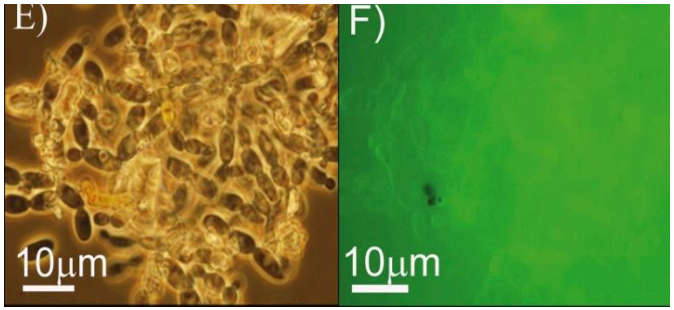


Fibers

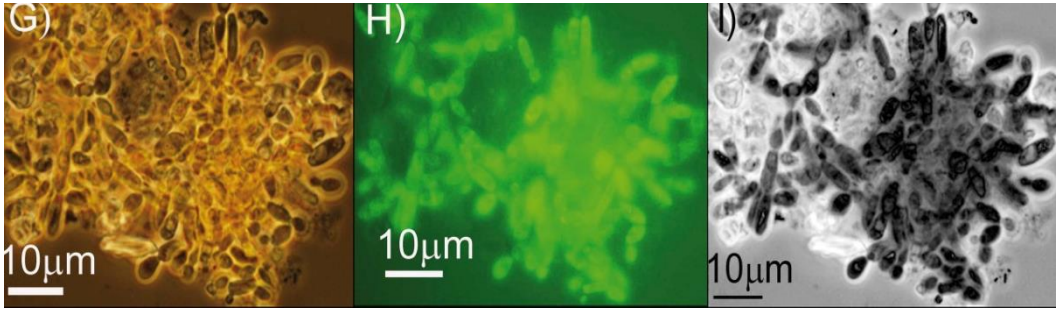


WORKING MECHANISM

- Quick membrane depolarization (after 1h) was observed using a potencial sensitive fluorescence probe (oxonol)
- It was attributed to the high puntual concentration of Ca^{2+} at glass/membrane interface region.



• ***G1 (window soda-lime glass) -C. krusei***

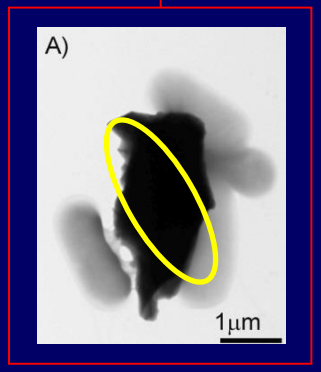


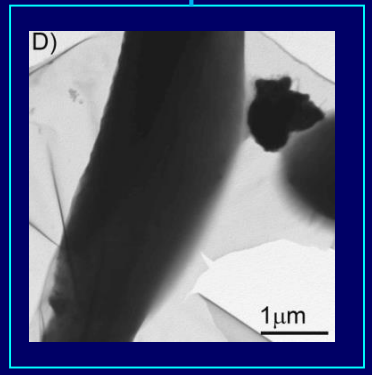
• ***G3-C. krusei***

E. coli culture supplemented with G3 (A)

M. luteus culture supplemented with G3 (C)

C. krusei culture supplemented with G3 (D)





The high concentration of Ca^{2+} close to membrane distorted the membrane electrochemical potential gradient avoiding nutrient exchange, inducing the death of the cell.

POSITIONING

Disadvantages of other biocides

Classic organic biocides have limited their applications due to their:

- Low heat resistance
- High decomposability
- Durability-Short life
- High toxicity
- Antimicrobial resistant

Benefits of G3® Glass

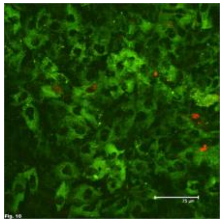
Versatiliy

Excellent compatibility with materials
Easy to use
Low-cost

Security

Not toxic
Biodegradable
Controlled release

SAFETY: G3® biocide is considered **non-cytotoxic** according ISO 10993-5, standard for biomaterial and medical device testing.



Microbiologycal Efficacy

Broad spectrum
Fast-acting
Not antimicrobial resistance generator

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SCIENTIFIC REPORTS

OPEN

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Histological response of soda-lime glass-ceramic bactericidal rods implanted in the jaws of beagle dogs

José S. Moya[1,2], Arturo Martínez[3], Roberto López-Píriz[1], Francisco Guitián[3], Luis A. Díaz[1], Leticia Esteban-Tejeda[2], Belén Cabal[1], Federico Sket[4], Elisa Fernández-García[1], Antoni P. Tomsia[5] & Ramón Torrecillas[1]

SCIENTIFIC REPORTS

OPEN

SUBJECT AREAS:
INFECTION
BIOMEDICAL MATERIALS
ANTIMICROBIAL RESISTANCE

Received

A New Biocompatible and Antibacterial Phosphate Free Glass-Ceramic for Medical Applications

Belén Cabal[1], Luis Alou[2], Fabio Cafini[2], Ramiro Couceiro[3], David Sevillano[2], Leticia Esteban-Tejeda[4], Francisco Guitián[3], Ramón Torrecillas[1,5] & José S. Moya[4]

BROAD RANGE OF ANTIMICROBIAL ACTIVITY

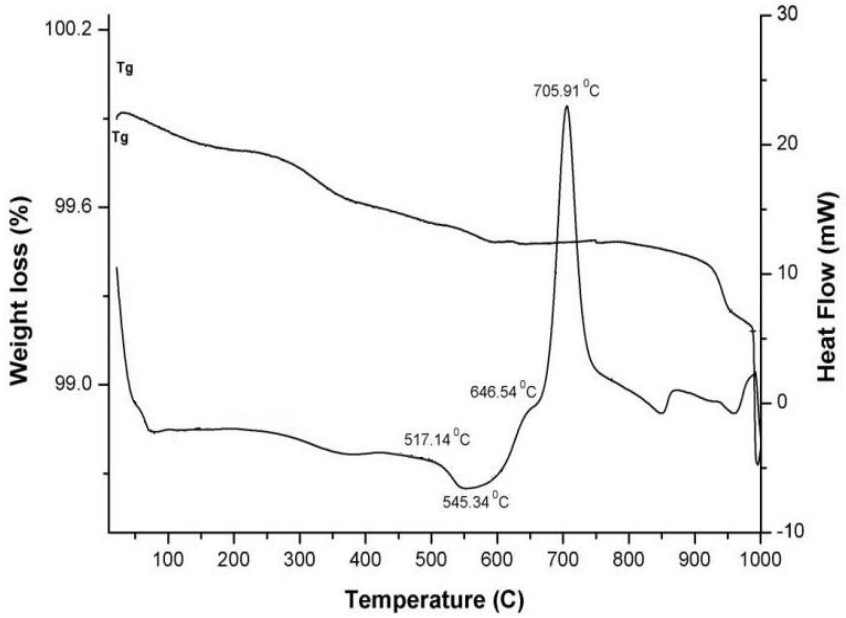
	Gram negative bacteria					
	E. coli	*P.aeruginosa*	*L. pneumophila*	*Sphingomonas spp.*	*S. typhimurium*	*S. putida*
Glass G3	✓	✓	✓	✓	✓	✓

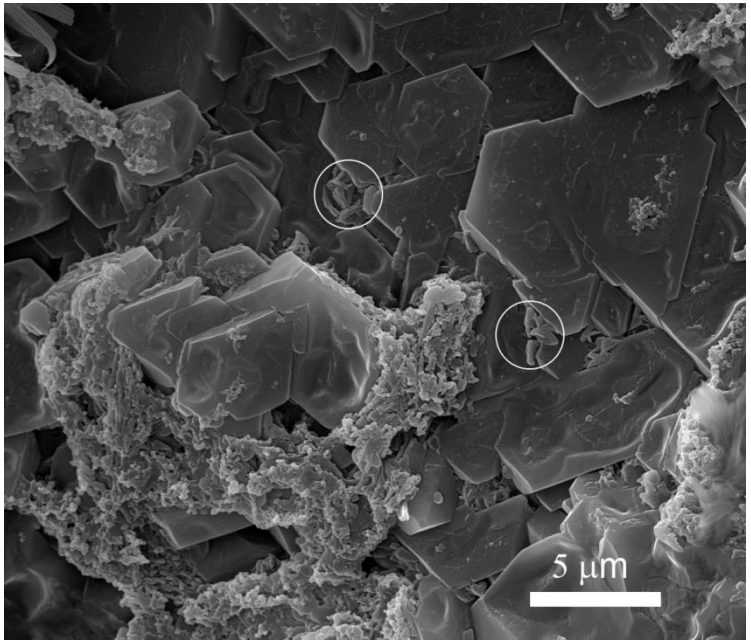
	Gram positive bacteria							
	M. luteus	*S. aureus*	*S. epidermidis*	*S. oralis*	*S. mutans*	*B. cereus*	*B. subtilis*	*MRSA*
Glass G3	✓	✓	✓	✓	✓	✓	✓	✓

	Yeast	Fungus	
	C. crusei/I. orientalis	*Trichoderma spp.*	*P. aurantiogriseum*
Glass G3	✓	✓	✓

HEAT RESISTANCE

After heat treatment at 750ºC, devitrification of the G3 glass leads to a **glass-ceramic** material composed of two crystalline phases (combeite and nepheline) dispersed in a glassy matrix. The CaO content in the residual glassy phase is similar to that of the parent glass.





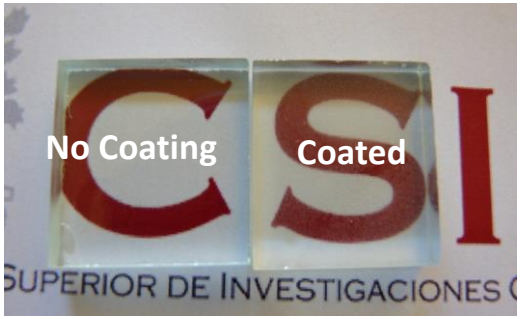
In addition to its bactericidas activity, the **mechanical properties** of the Glass-Ceramic are twice that of Glass: $\sigma_{f=130}$ **MPa , Kic=1.6 MPa** $m^{1/2}$

	Transition temperature T_g (ºC)	Thermal expansion coefficient α ($10^{-6}K^{-1}$)
G3® GLASS	540	14.2

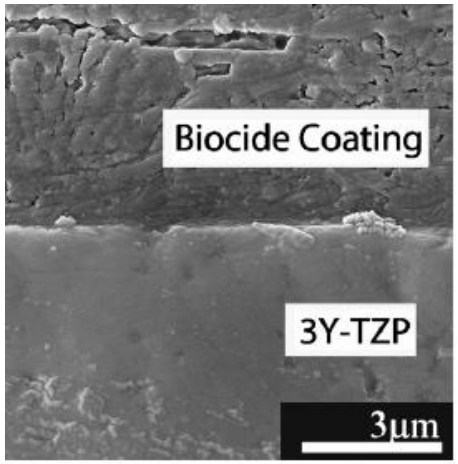
COATINGS ON DIFFERENT SUBSTRATES

Effectiveness guaranteed, meets Japanese Industrial Standard JIS Z 2801 and ISO22196, which measures the antibacterial activity

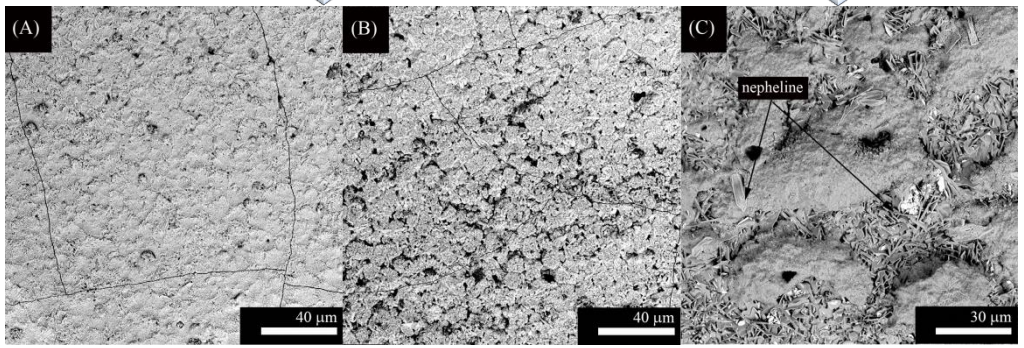
Glass

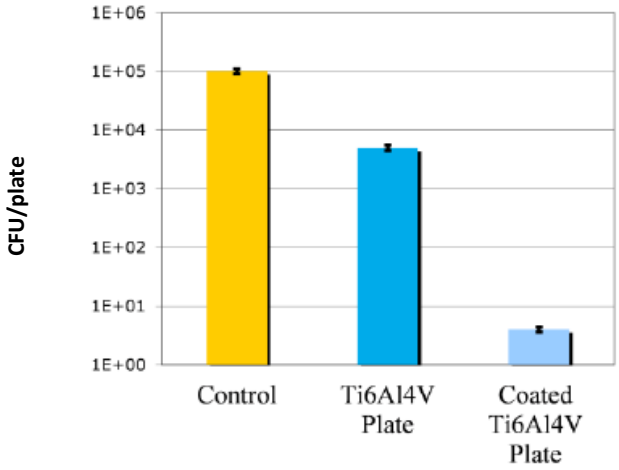


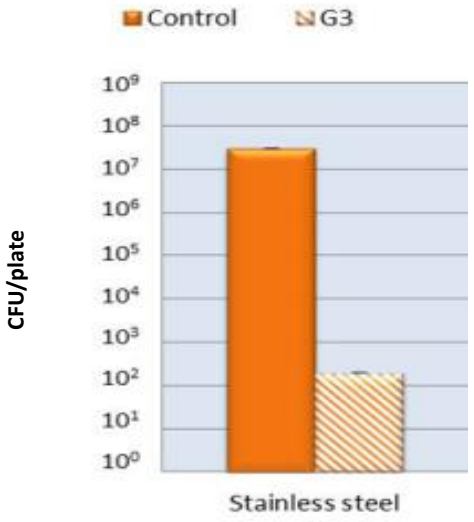
Ceramic



Titanium alloy | Stainless steel



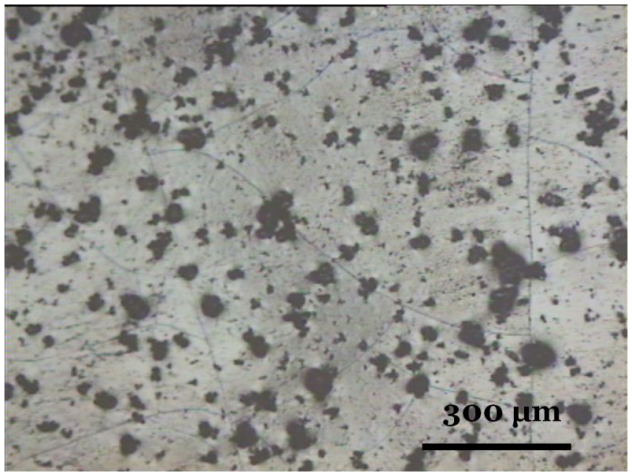


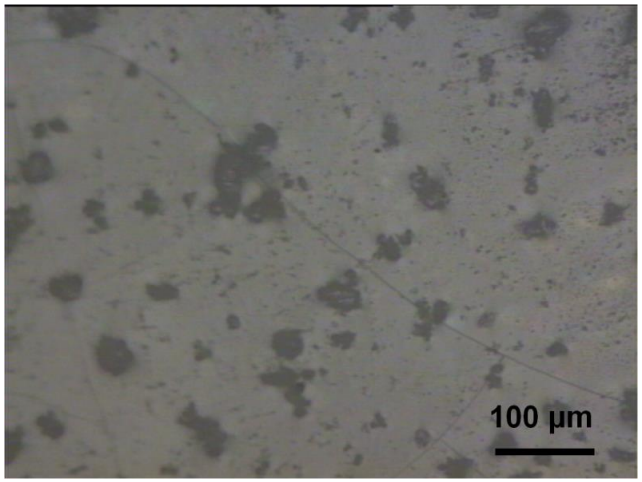


**Esteban-Tejeda et al. Material Letters 2013*
**Esteban-Tejeda et al. International Journal of Molecular Sciences 2014;15:13030-44*
**Díaz LA et al. Journal of the European Ceramic Society 2016*

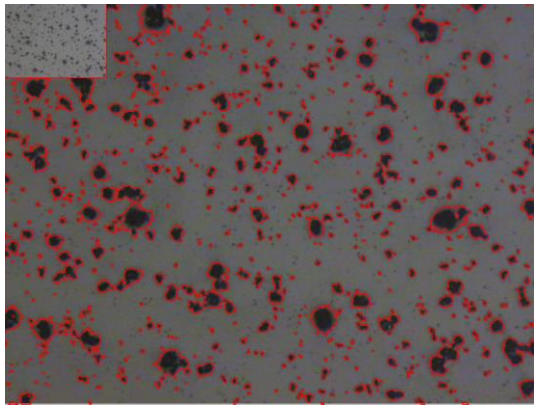
COATINGS ON DIFFERENT SUBSTRATES

G3® (heat-treated) on glazed Al_2O_3 plates (750 ºC -30 min)



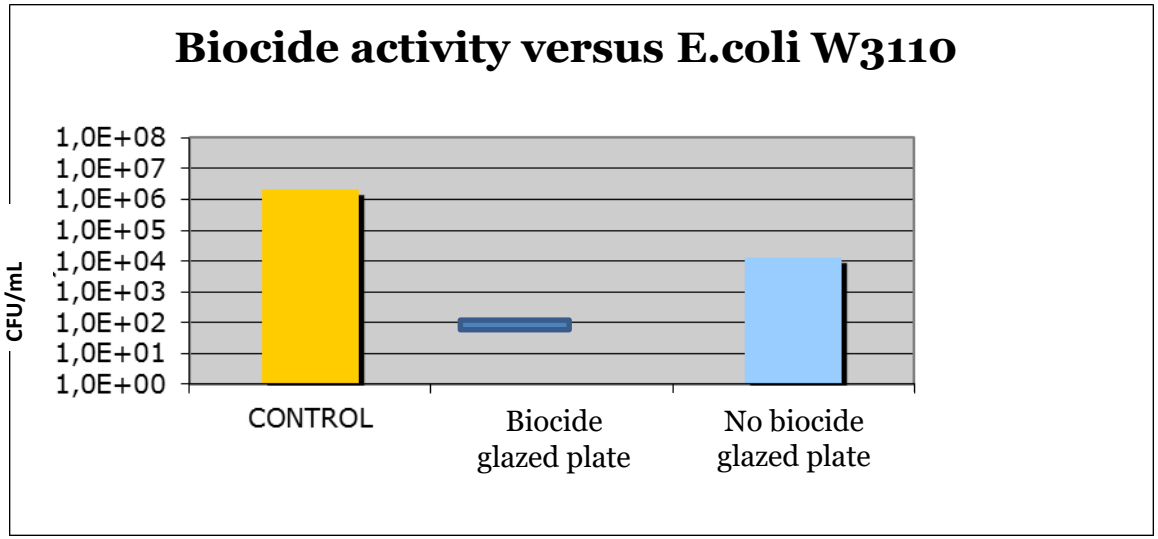


Calculation of the coated area:



Aprox. Quantity of the Biocidal Glass

14.9%



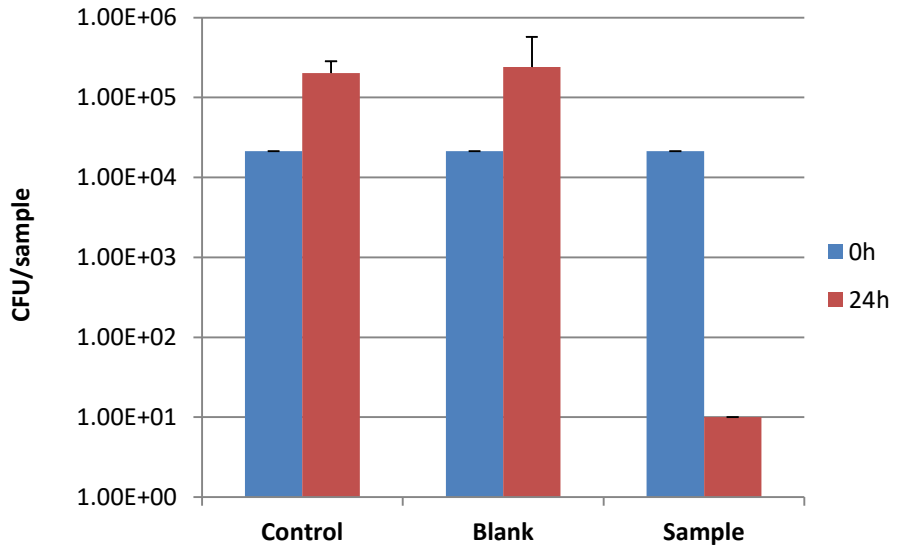
RESULTS IN PAINTS

Effectiveness guaranteed, meets Japanese Industrial Standard JIS Z 2801 and ISO22196, which measures the antibacterial activity

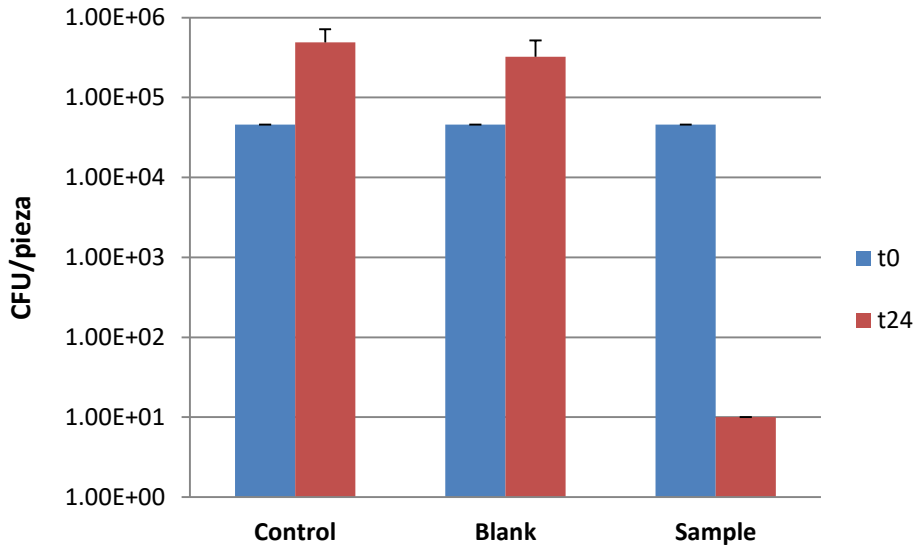
Test on Antimicrobial Efficacy: ISO 22196:2011

Samples	Description
Control	Petri Plates
Blank	Painted samples (5 x 5 x 0.2 cm) without G3® glass
Sample	Painted samples (5 x 5 x 0.2 cm) with G3® glass

S.Aureus ATCC 8739



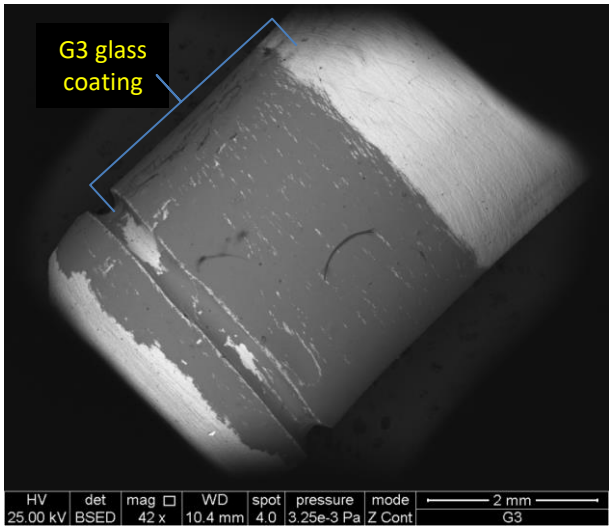
MRSA ATCC 43300

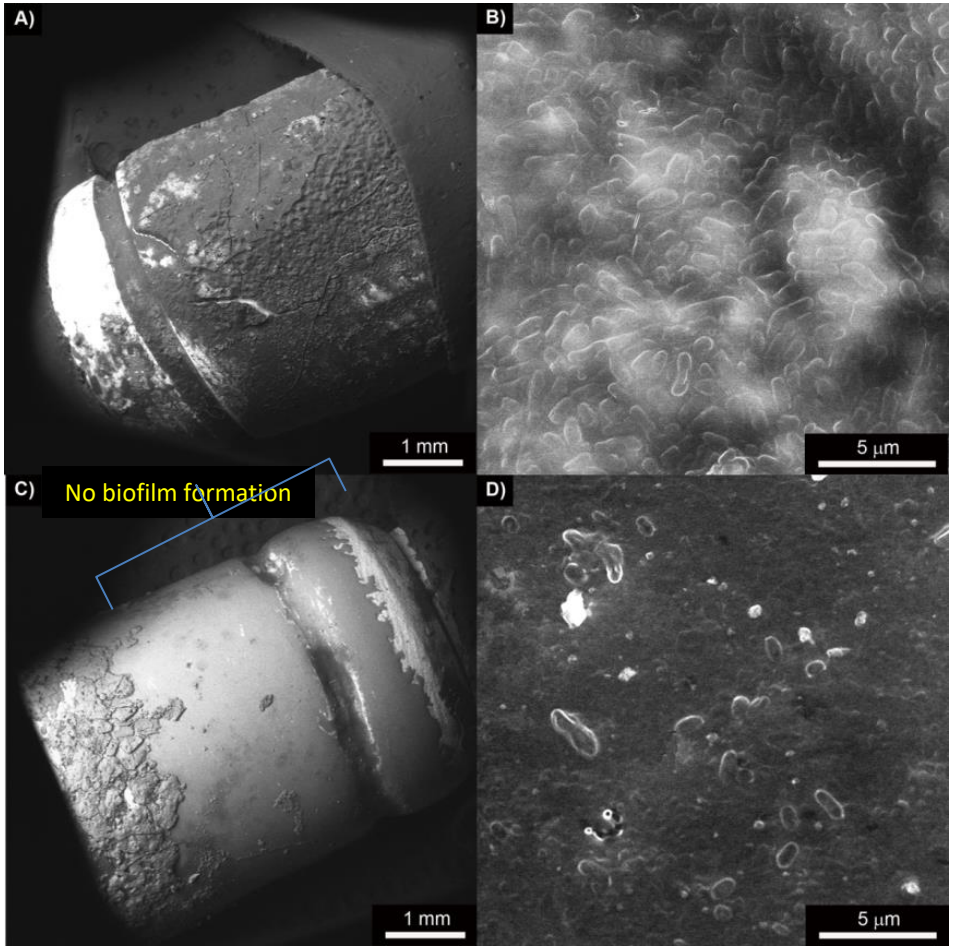


RESULTS OF AN IN VIVO STUDY

Scanning electron micrographs at different magnifications of:
A) and B) **uncoated** zirconia abutment,
C) and D) G3® glassy **coated** zirconia abutment.

At the beginning





Biofilm formation occurred only in the part of the abutment free of coating (Fig 4C) and significantly few microorganisms are shown in the abutment coated with glass G3® (Fig 4D).

**López-Píriz et al. Plos One. 2015, 10(10), e0140374*

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All in a 15 Kms Radius at the heart of ASTURIAS

– thank you