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Antibacterial activity and biofilm inhibition of a novel bioactive glass coating on titanium

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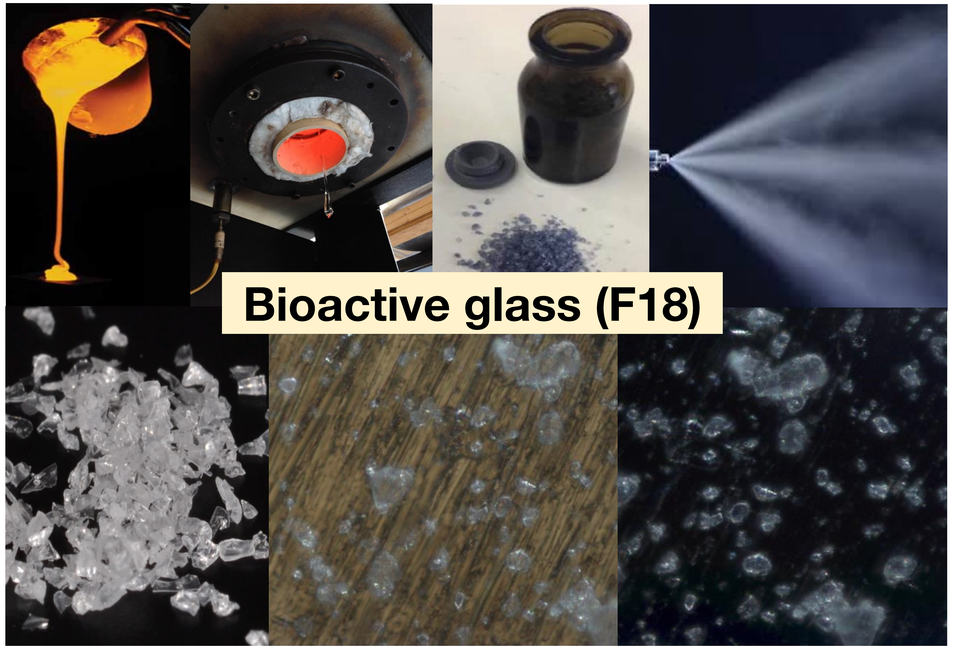
Introduction

Biofuncionalization with bioactive glass F18 into surfaces

SiO_2-CaO-Na_2O-MgO-K_2O-P_2O_5. system

Bioactive glasses are highly active materials that can induce the upregulation of osteoblasts proliferation and differentiation resulting in a biologically active bone on their surface.

Peitl et al., 2012; Souza et al., 2014



A novel surface with bioactive glass (BSF18)

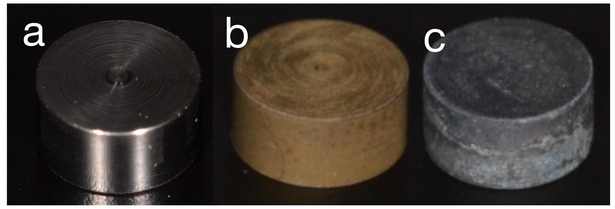
Center for Research, Technology and Education in Vitreous Materials
Zanotto Lab, Brazil

Aim

This study aimed to investigate the anti-biofilm and bactericidal activity against *Staphylococcus aureus* biofilm biofunctionalized discs with this bioactive glass

Material and Methods

Discs and surfaces

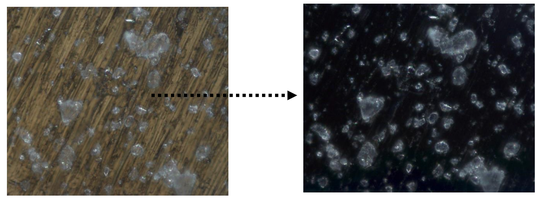


S.I.N.
Implants Company
Brazil

6.0mm diameter
3.0 mm thickness

Groups a: Machined (M)
b: Nano-Hydroxyapatite (Nano-Ha)
c: Bioactive glass (BSF18)

Biofunctionalized with bioactive glass



Biofunctionalization with bioglass particles (SiO_2-Na_2O-K_2O-MgO-CaO-P_2O_5 system) through the pneumatic atomization technique (50 µm) – **Patent 2014 003817 5 (Brazil)**
Vitreous Materials Laboratory, UFSCar

Surface characterization

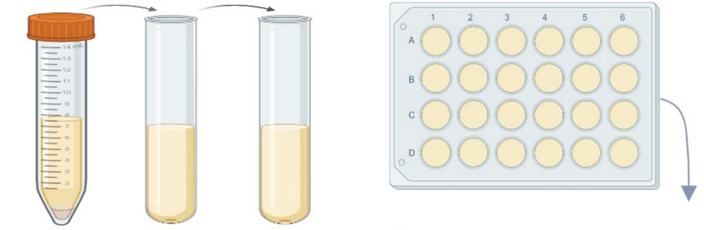
Physical-chemical properties of the surface:

- Energy dispersive spectroscopy (EDS)
- Scanning electron microscopy images (SEM)
- Atomic force microscopy (AFM)
- Bioactivity assay (FTIR)

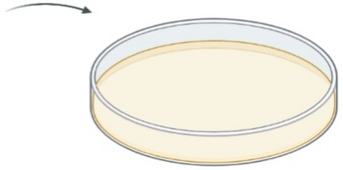
Contamination of discs

Staphylococcus aureus

ATCC 6538



10^6 CFU/mL



Experimental Model
(JIS Z 2801:2010
ISO 22196: 11 standards)



Antibacterial activity

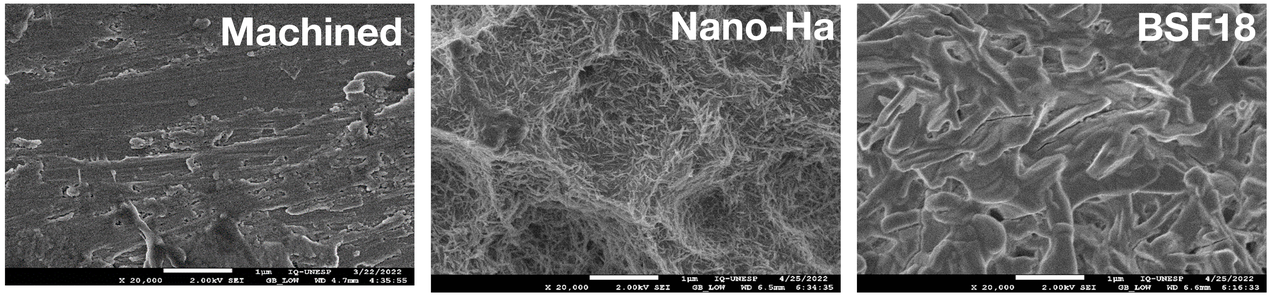
after 24 hours:

- UFC/mL *(Reduction of biofilm)*
- Biofilm morphology *(SEM images)*
- Confocal laser scanning microscopy *(Live and Dead cells)*

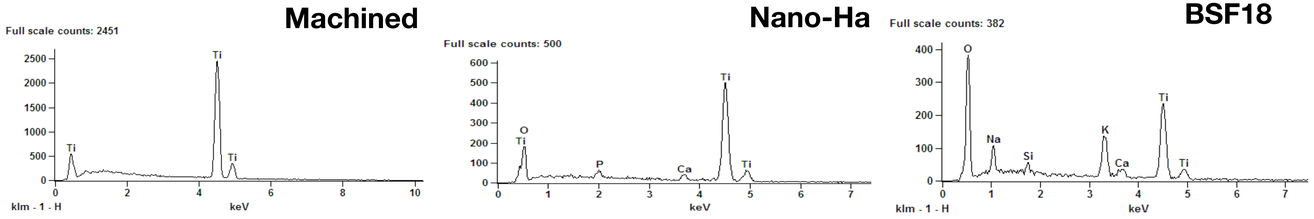
Results

Surface characterization

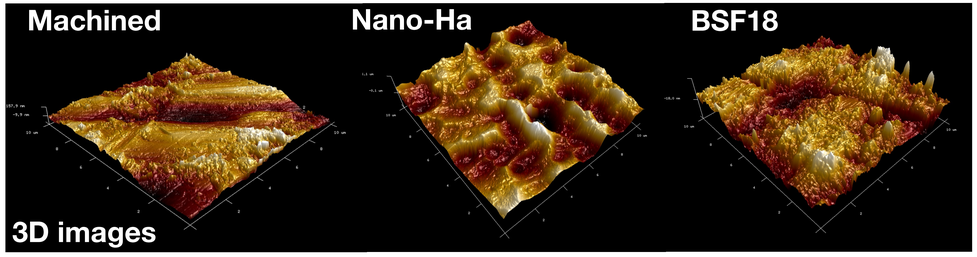
Scanning electron microscopy 20.000x



Energy dispersive spectroscopy % chemical composition



Atomic force microscopy Roughness



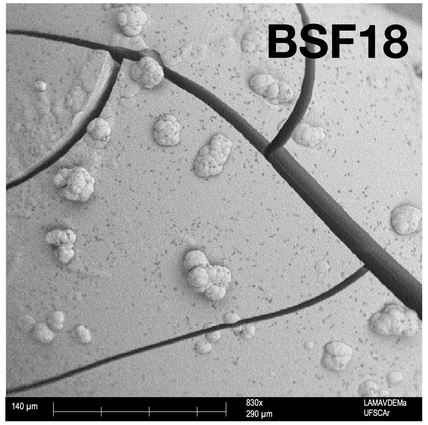
Sample	R_a (nm)	R_q (nm)	R_{max} (nm)
Machined	0.52±1.52	3.95±15.53	36±13.42
Nano-Ha	1.35±3.84*	27.25±65.29*	174±21.1*
BSF18	1.14±5.3	15.75±65.92	144±54.3

Values (Mean±Standard Deviation)
Kruskal Wallis test ($p<0.05$)

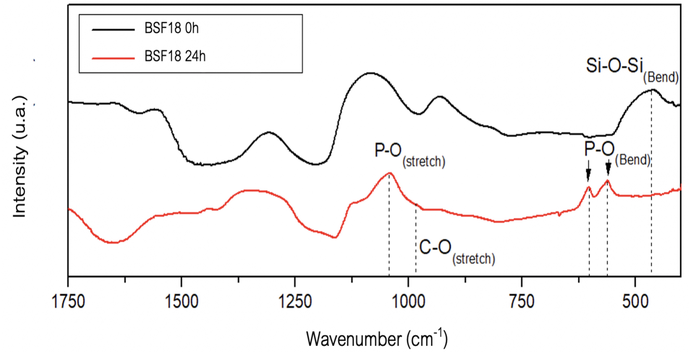
Bioactivity assay

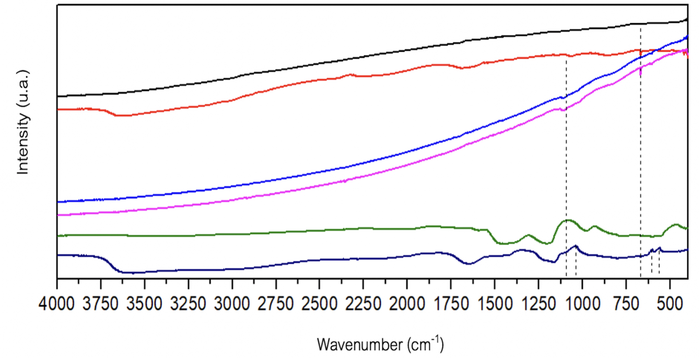
Simulated Body Fluid (24h)

Hydroxycarbonate apatite formation



M 0h
M 24h
Nano-Ha 0h
Nano-Ha 24h
BSF18 0h
BSF18 24h

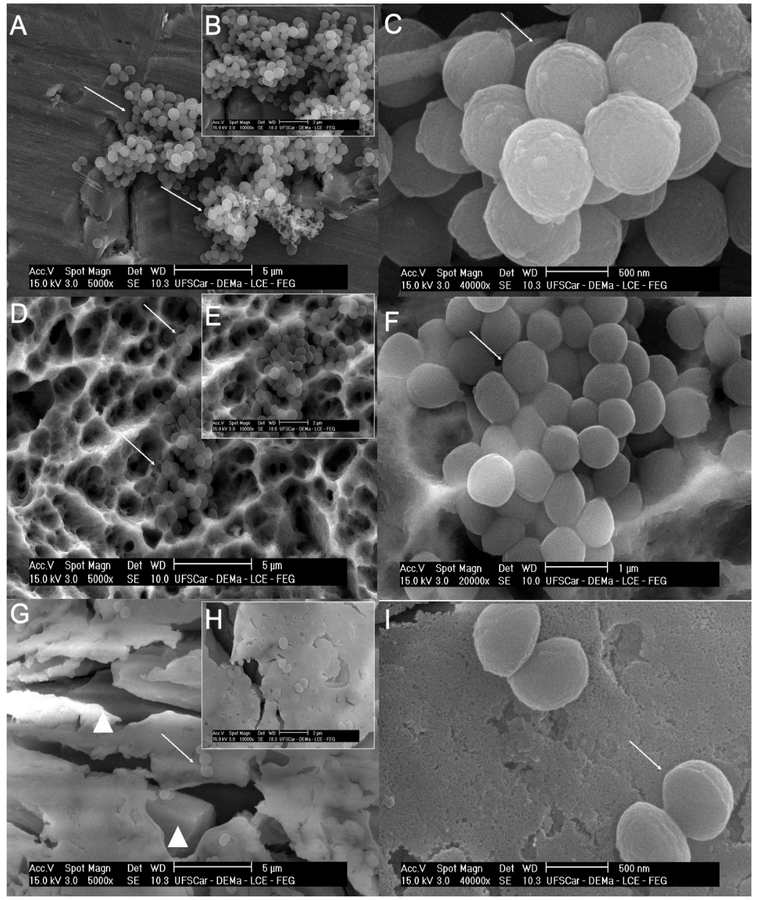




Results

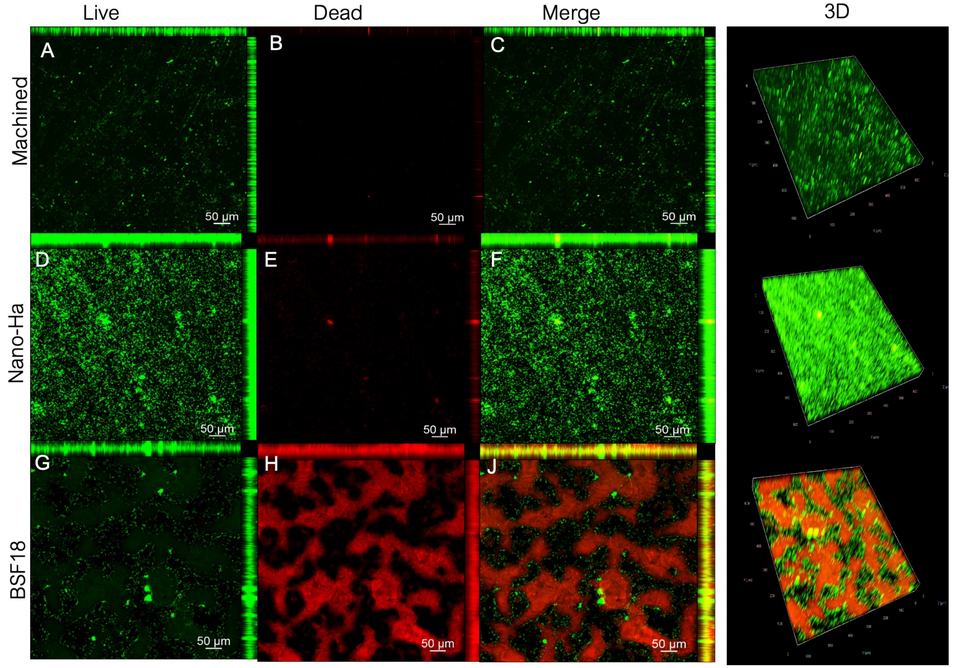
Antibacterial activity

Biofilm Morphology



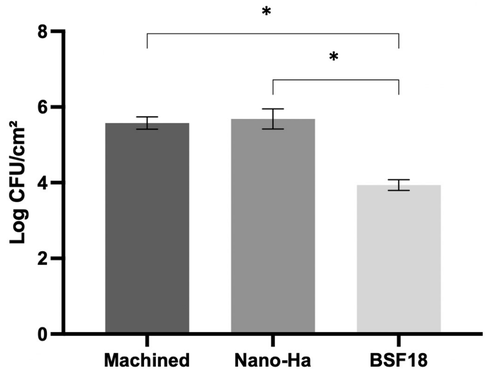
Confocal laser microscopy

Live & **Dead**



Reduction of bacterial biofilm CFU/mL

(* p<0.0001)



Conclusion & Clinical Implication

It can be concluded that F18 coating could be a valid infection-preventing strategy for implant dentistry clinical practice.

Acknowledgments

- Sao Paulo Research Foundation (FAPESP) grants numbers 2021/00632-3 and 2013/07793-6 – CeRTEV- Center for Research, Technology, and Education in Vitreous Materials, Brazil.
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FAPESP

S.I.N. Implant System