Secondary caries inhibition of different ion-releasing restorations

Eman Albelasy, Tamer Abdelrehim, Rouqiong Chen, Hooi Pin Chew

materials

MDPI

Review

Commercially Available Fluoride-Releasing Restorative Materials: A Review and a Proposal for Classification

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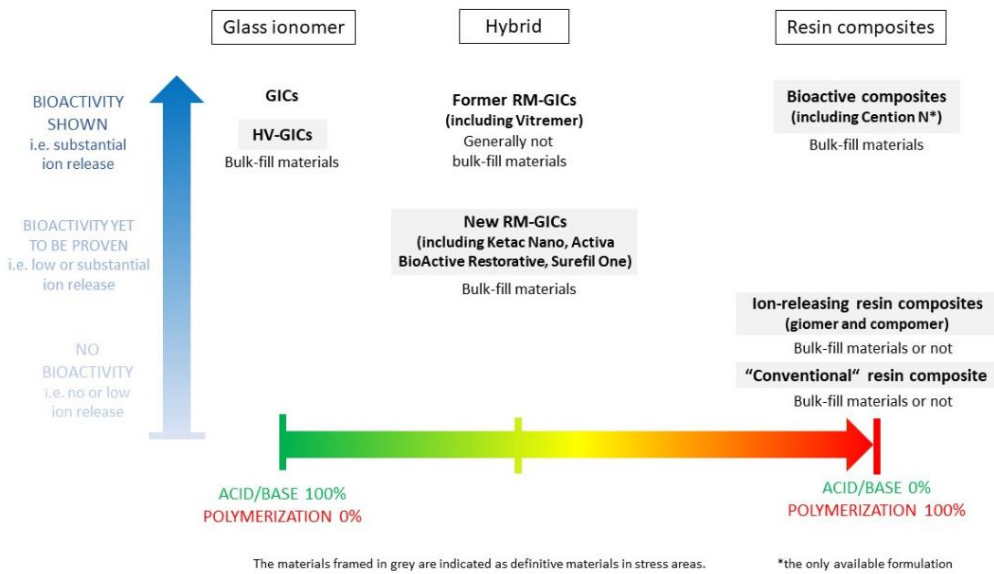


Objectives

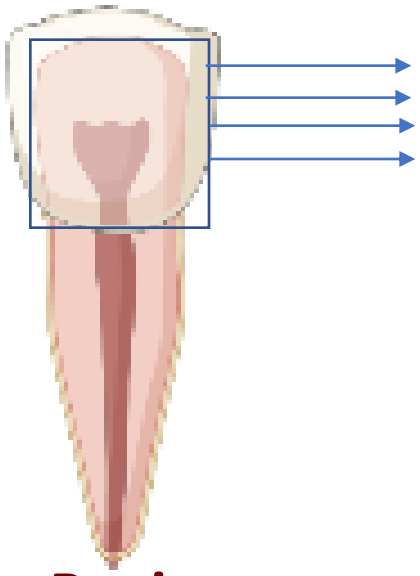
1. Do the composite hybrid and ion-releasing composite possess a secondary caries inhibitory effect in comparison with a conventional glass ionomer and a negative control of resin composite

.2. Is there a difference in secondary caries inhibitory effect between the materials in a Ph cycling model vs a biofilm model

.3. Is there a difference in demineralization severity between the enamel directly at the restoration margin and away from it

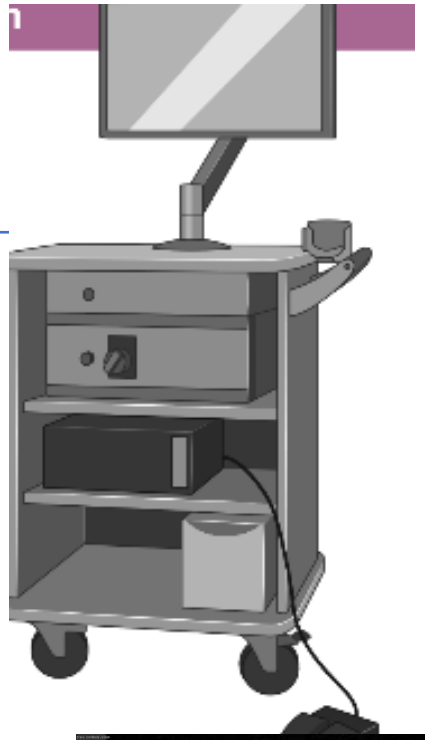
Material	Specification	Manufacturer	Composition
Surefil one composite hybrid	Self-adhesive, bulk-fill composite hybrid	Dentsply Sirona	Modified polyacid (MOPOS), Bifunctional acrylate (BADEP), Acrylic acid, Water, Reactive glass filler, non-reactive glass filler, Initiator, Stabilizer
Cention N	Alkasite, Ion releasing self-cure composite	IvoclarVivadentAG, Schaan, Liechtenstein	Liquid monomers: Dimethacrylate 95 – 97%, Additive 1 – 2 %, Initiator 2-3 %, stabliser < 1%. Powder: Calcium fluorosilicate glass (25 – 35 %), Ba-Al silicate glass (20 – 30 %), Ca-Ba-Al fluorosilicate glass (10 – 20 %), Ytterbium trifluoride (5 – 10 %)
Tetri Powerfill	Bulk-fill resin composite	IvoclarVivadentAG, Schaan, Liechtenstein	Dimethacrylates (19.7%, Prepolymer 17%, arium glass filler, Ytterbium trifluoride, Mixed oxide 62.5, Additive, Initiators, Stabilisers, Pigments < 1.0
Tetric® N-Bond Universal	light-curing, single-component adhesive	IvoclarVivadentAG, Schaan, Liechtenstein	Methacrylates (60 – 70), Water, Ethanol (23-28%) Highly dispersed silicon dioxide 3 – 5, initiators and stablizers 3-5
Ketac Molar	Conventional GIC	3m ESPE, GmbH, Germany	Powder: ultrafine radiopaque aluminium-calcium-lanthanum-fluorisilicate glass, 5% spray dried ESPE. Liquid: polycarbonate acid polycarbonic acid and tartaric acid

Artificial secondary caries models

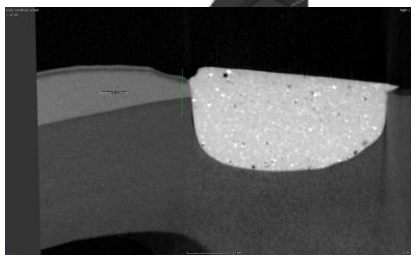


Bovine incisors

RC
GIC
CN
SU-O

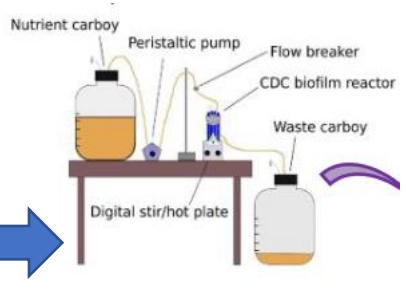


OCT



Micro Ct

6 days Biofilm Challenge



28 samples (n=7)

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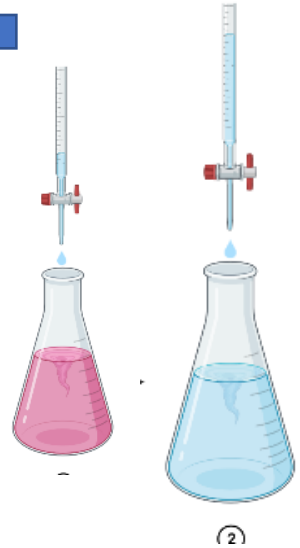
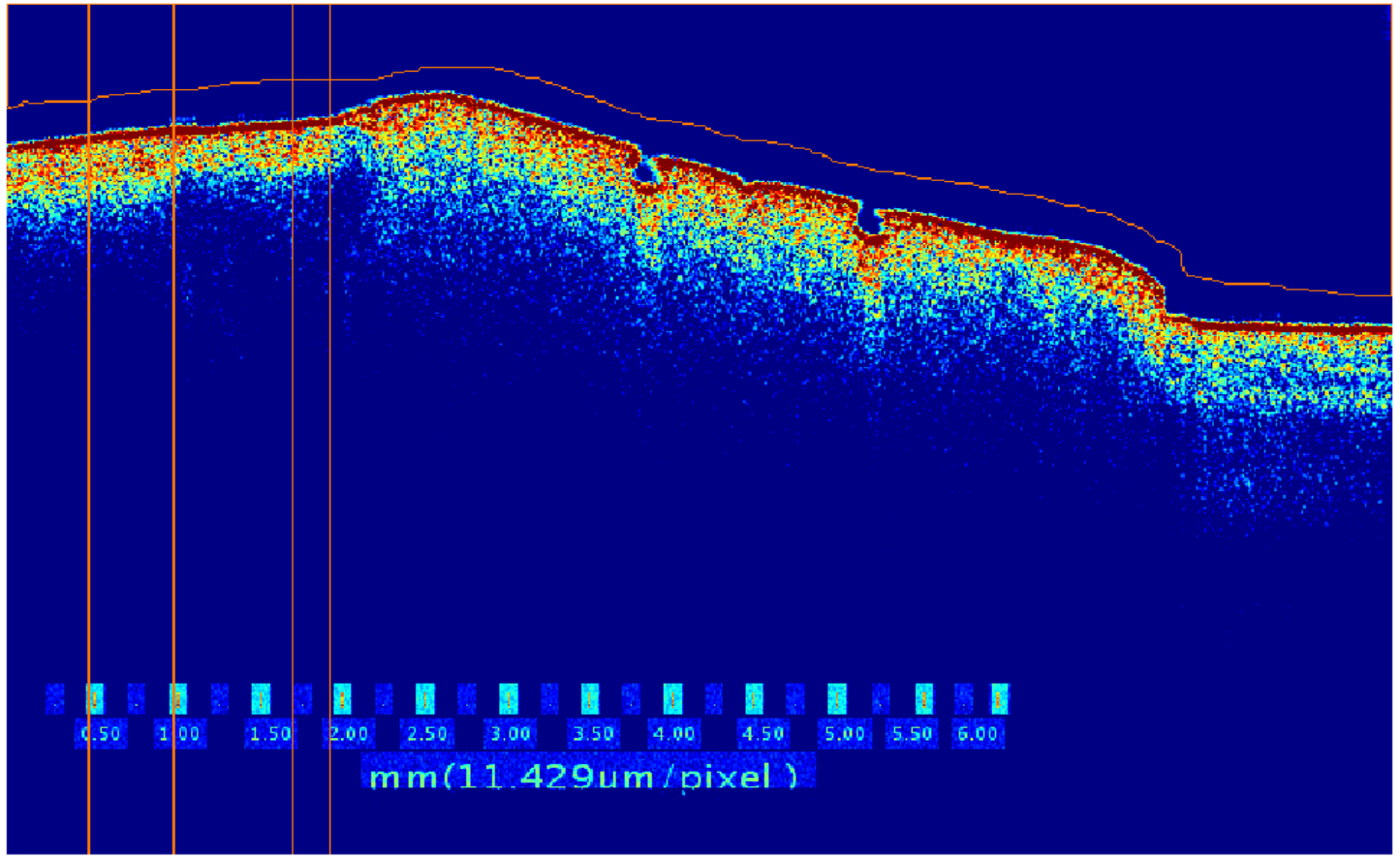


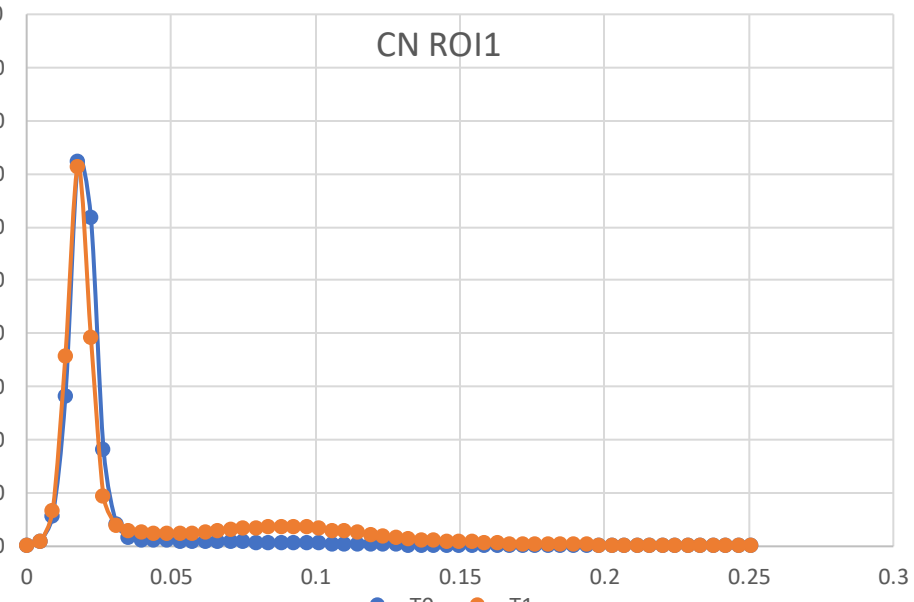
9-days Ph cycling

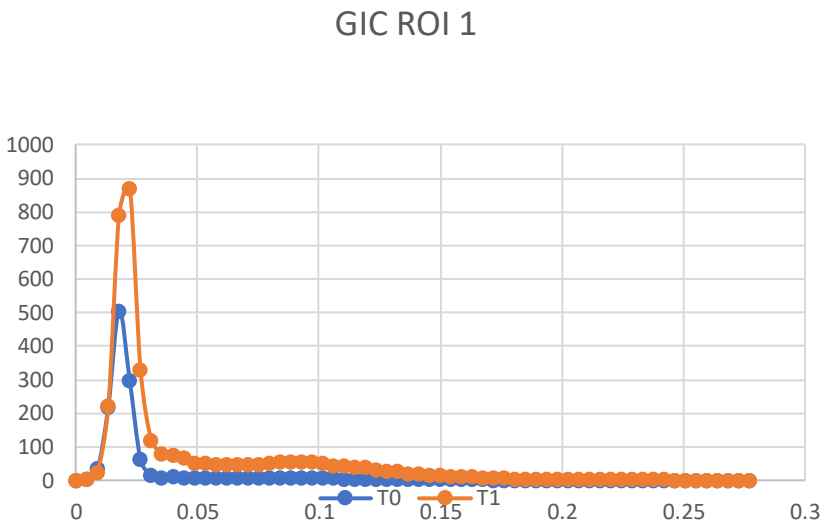
Regions of interest selection

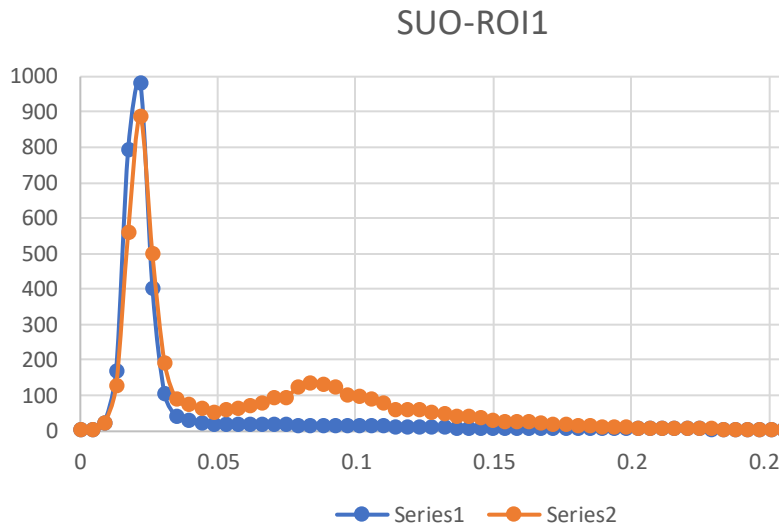
3.2 ROI.png

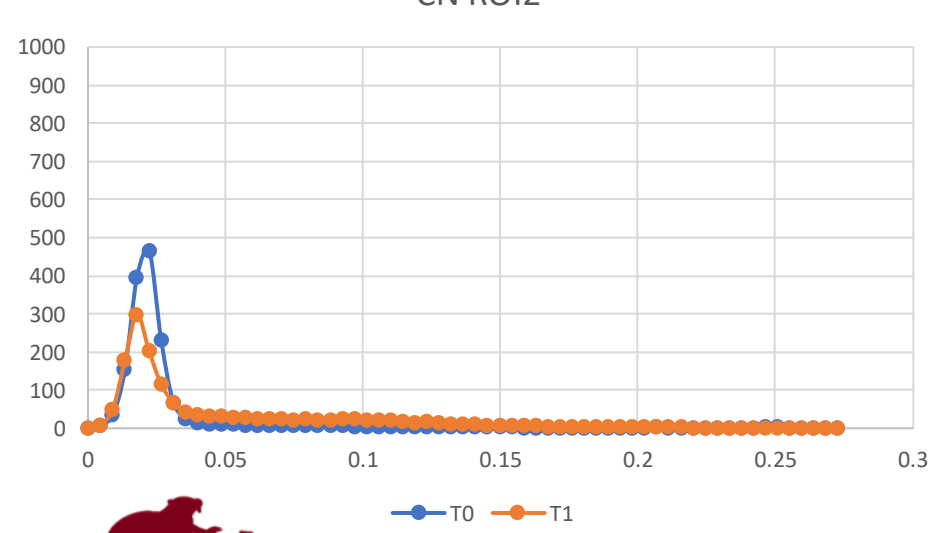


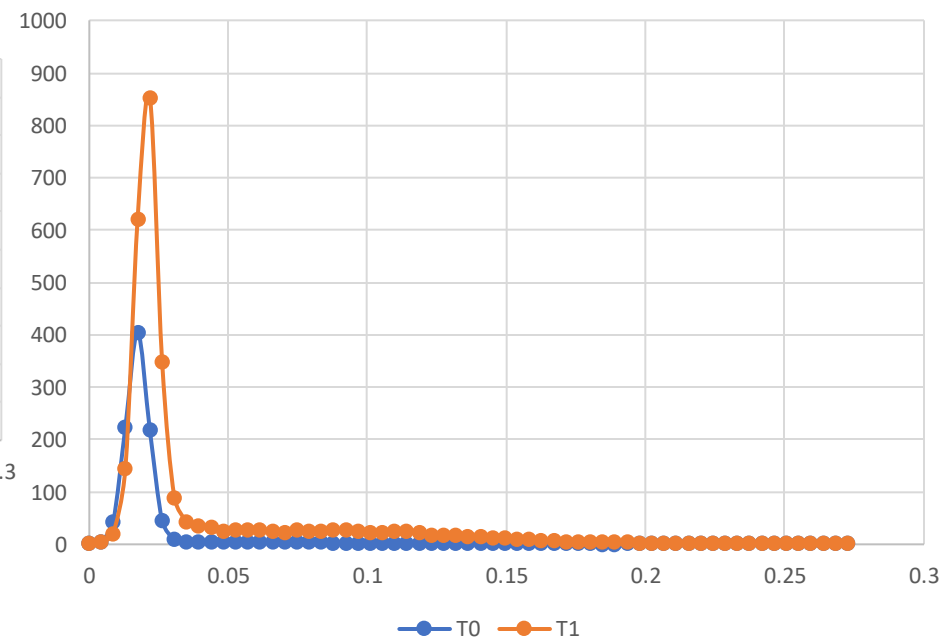
OCT Results/Biofilm model

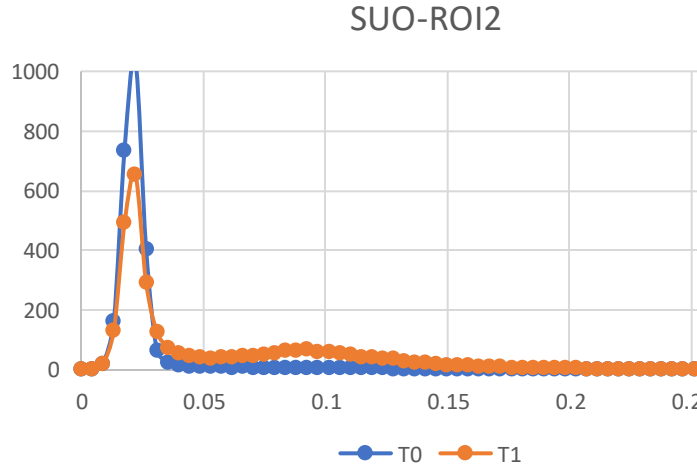




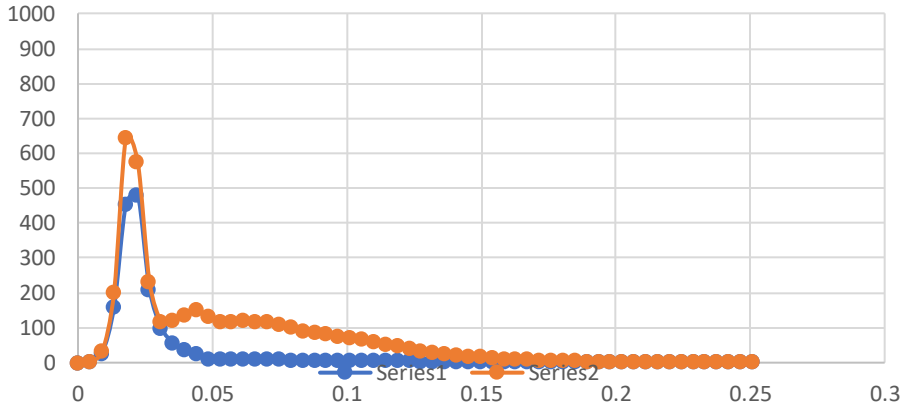




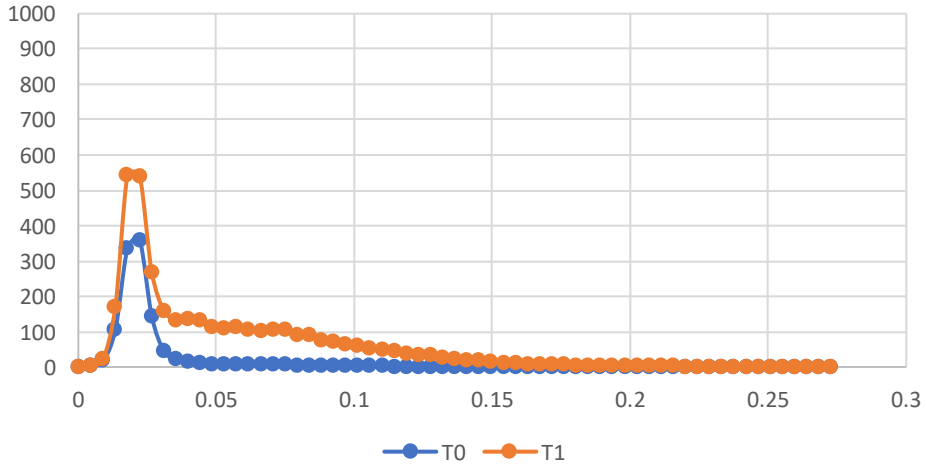




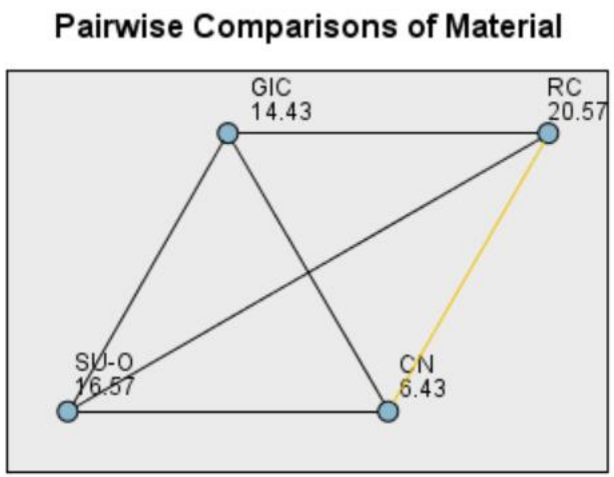
ROI 1 RC BIOFILM

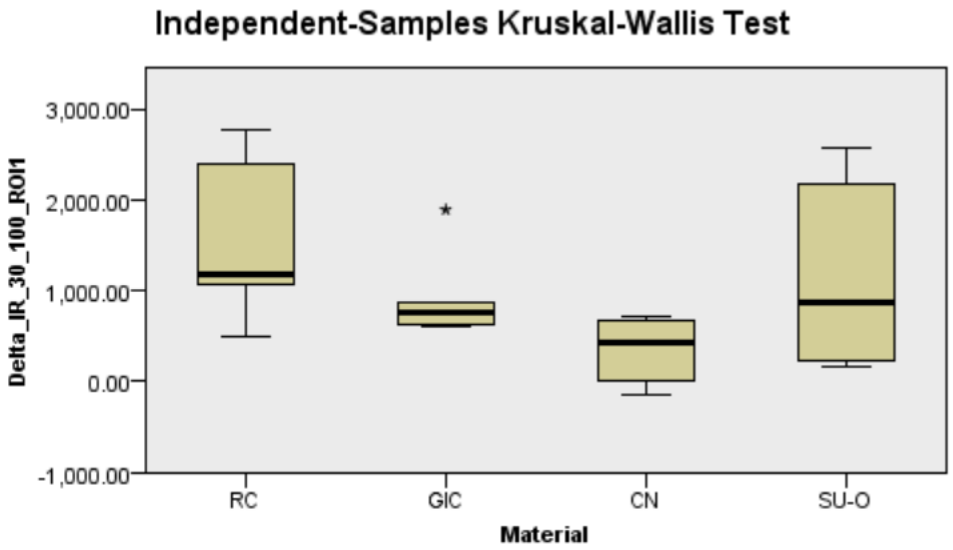


RC/ROI2



At a depth of 100 ROI1





All other depths

Delta_IR_30_150_ROI1

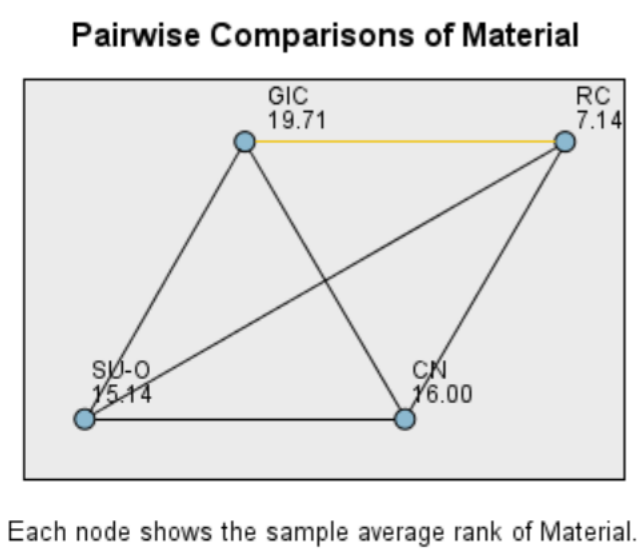
	Material	N	Subset 1	Subset 2
Tukey HSD[a,b]	CN	7	486.1803	
	GIC	7	1160.8553	1160.8553
	SU-O	7		1707.1951
	RC	7		1914.6654
	Sig.		.313	.226

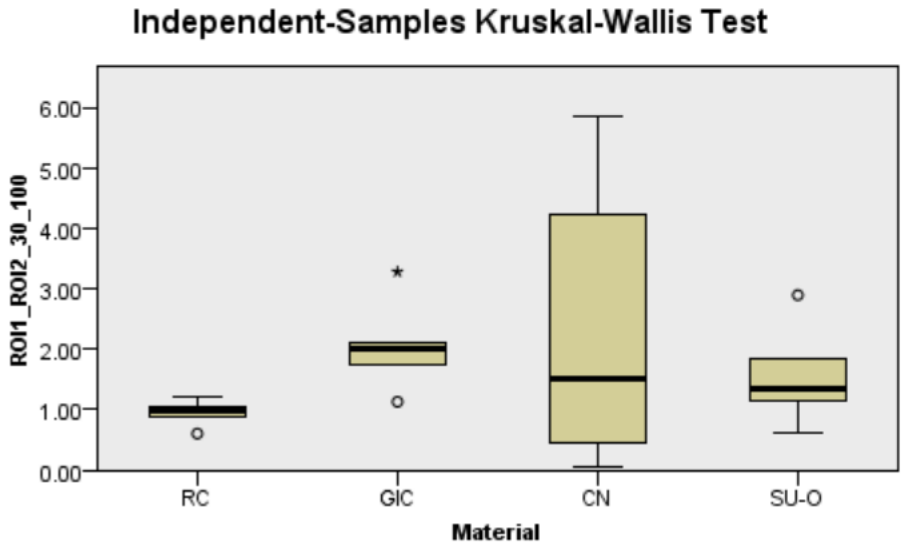
Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = 510402.785.

a. Uses Harmonic Mean Sample Size = 7.000.

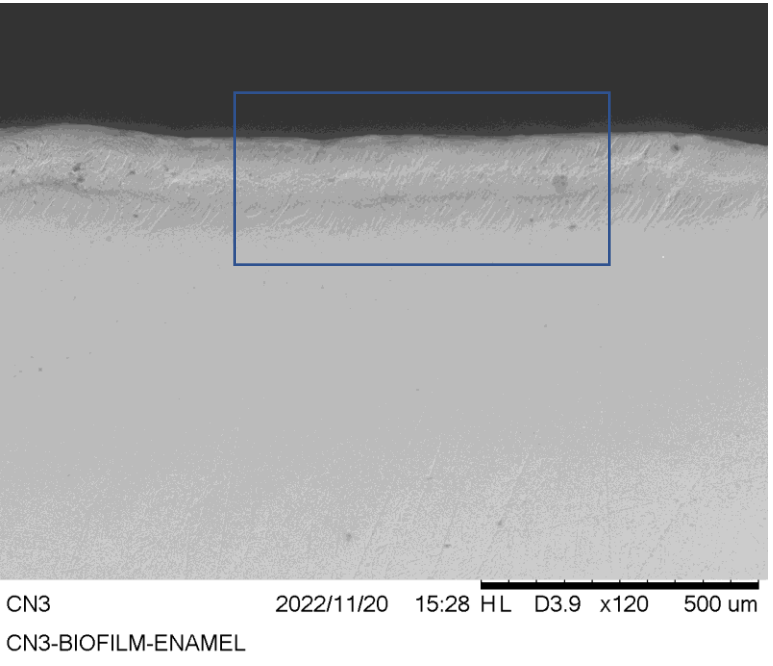
b. Alpha = 0.05.

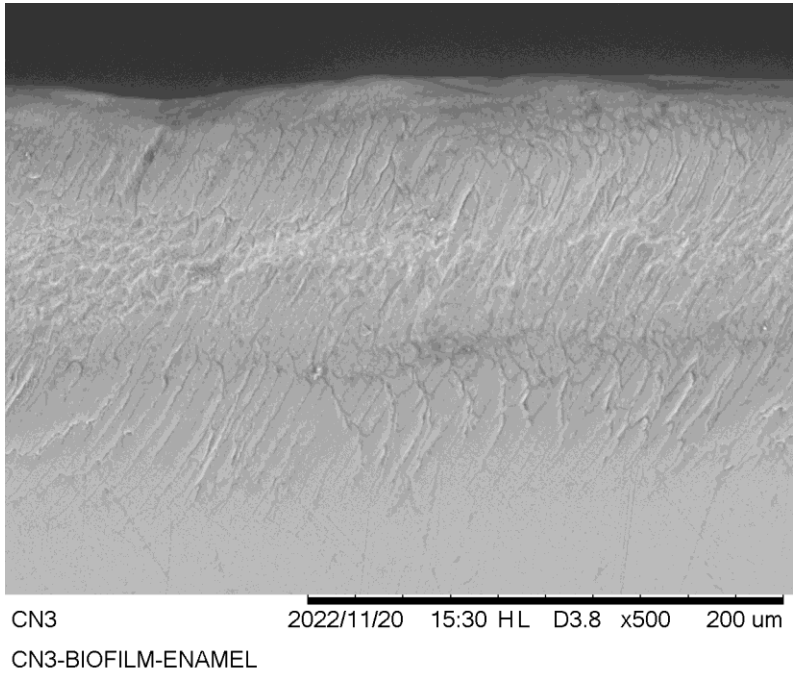
ROI1/ROI12

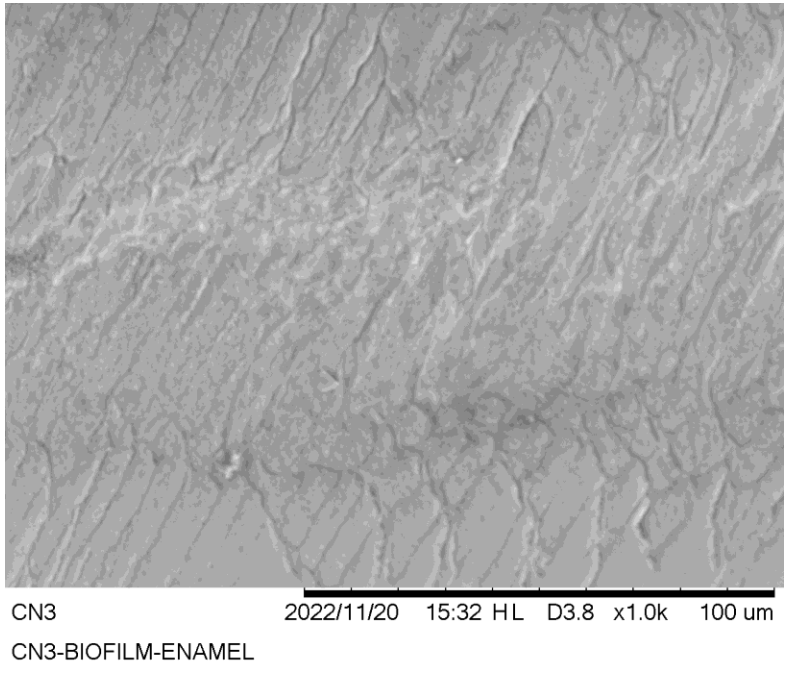

Pairwise Comparisons of Material
GIC
19.71
RC
7.14
SU-O
15.14
CN
16.00
Each node shows the sample average rank of Material.

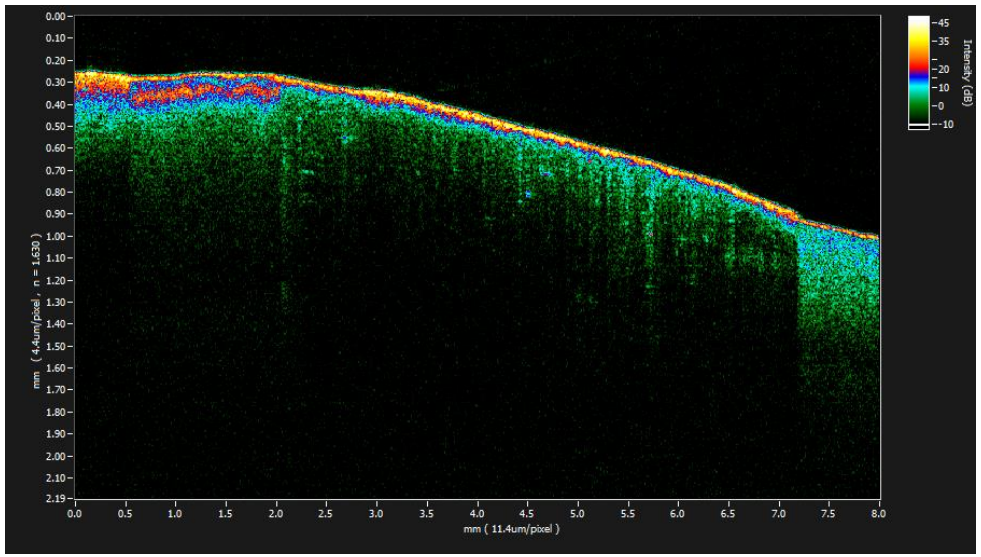

Independent-Samples Kruskal-Wallis Test
ROI1_ROI2_30_100
6.00
5.00
4.00
3.00
2.00
1.00
0.00
RC
GIC
CN
SU-O
Material

SEM evaluation

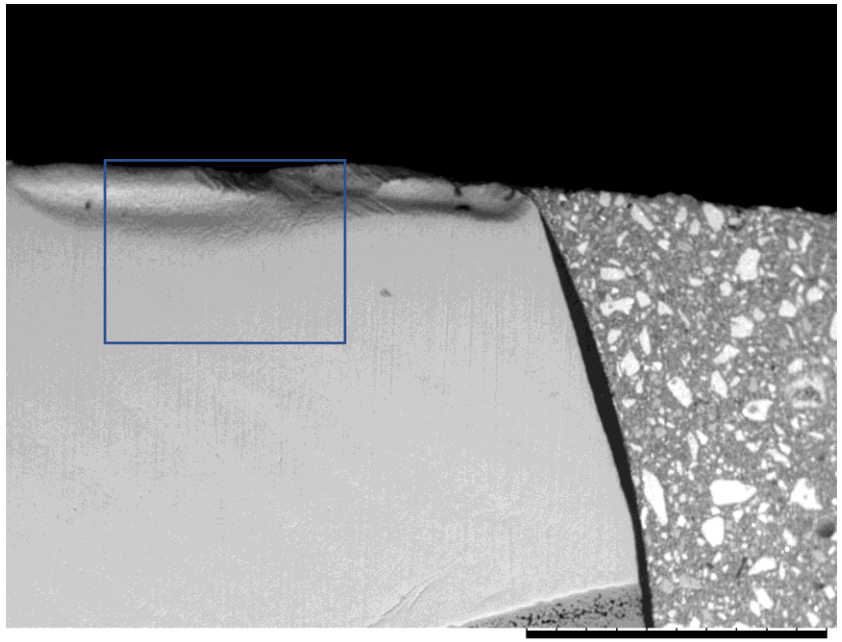

CN3 2022/11/20 15:28 HL D3.9 x120 500 um
CN3-BIOFILM-ENAMEL


CN3 2022/11/20 15:30 HL D3.8 x500 200 um
CN3-BIOFILM-ENAMEL


CN3 2022/11/20 15:32 HL D3.8 x1.0k 100 um
CN3-BIOFILM-ENAMEL

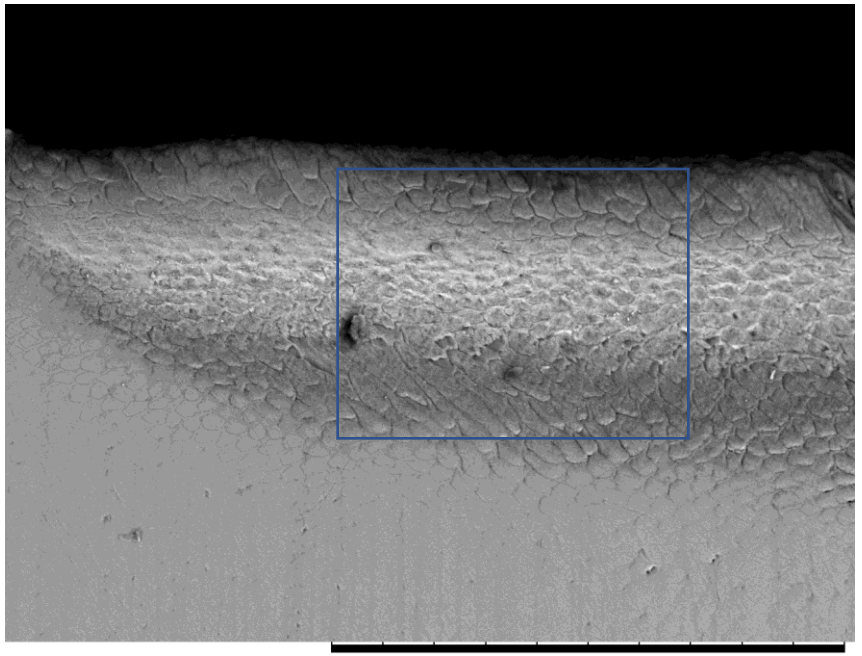

mm (4.4um/pixel , n = 1.630)
mm (11.4um/pixel)
Intensity (dB)

CN



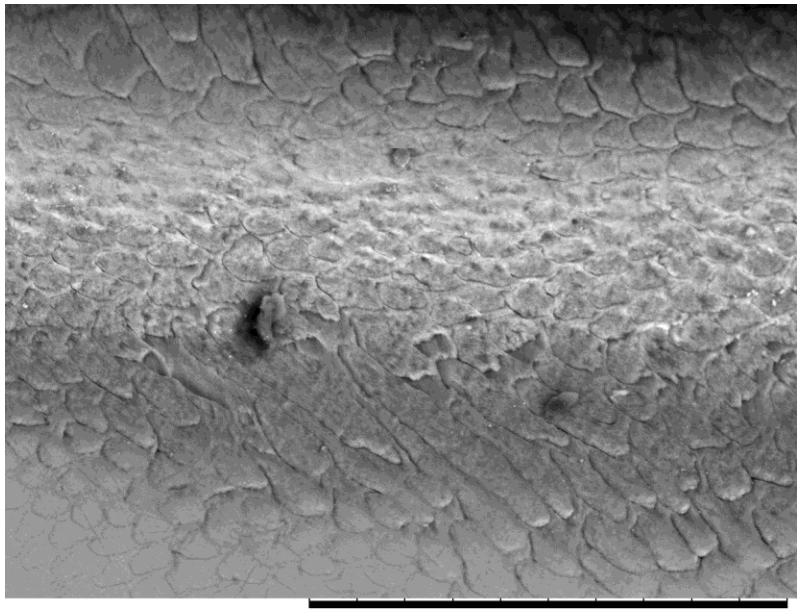
CN0048 2022/11/21 15:32 HL D4.6 x120 500 um

CN4



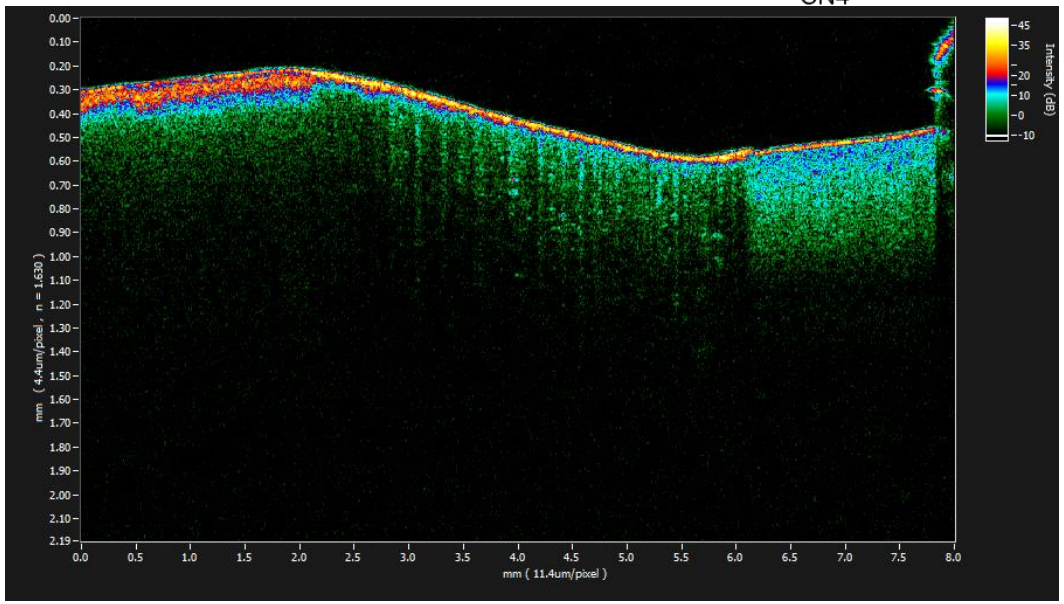
CN0051 2022/11/21 15:38 HL D4.9 x500 200 um

CN4

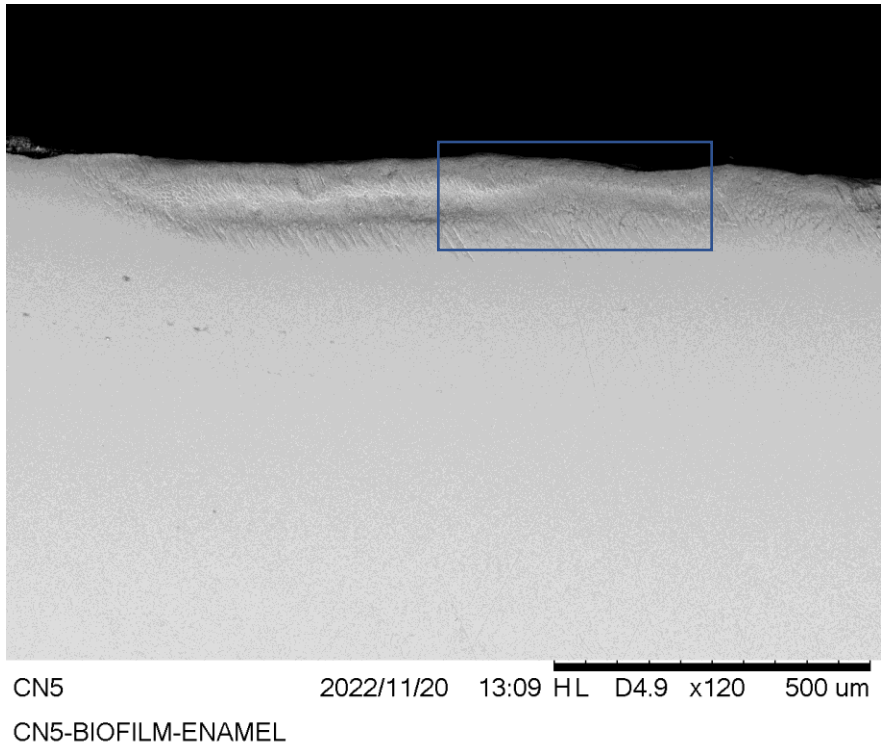


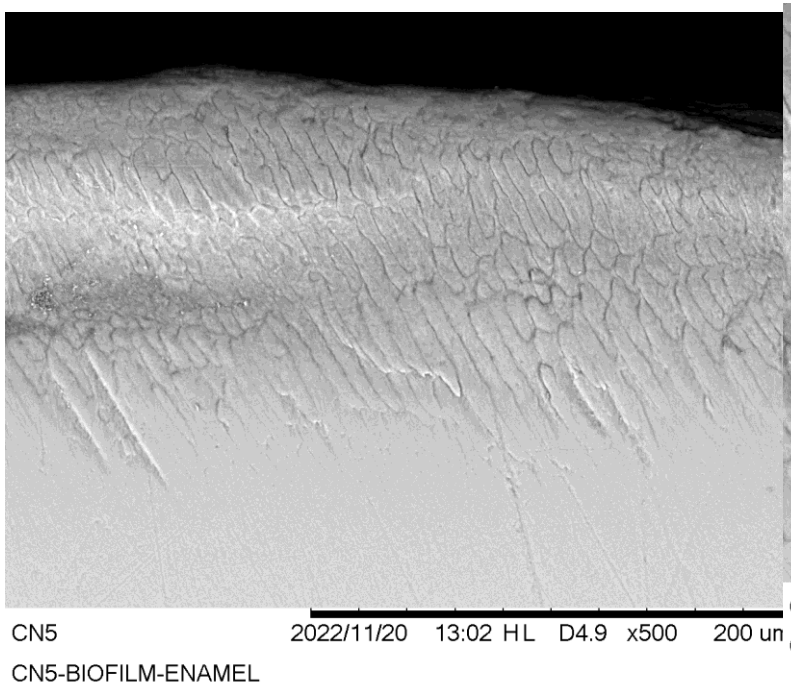
CN0052 2022/11/21 15:40 HL D4.9 x1.0k 100 um

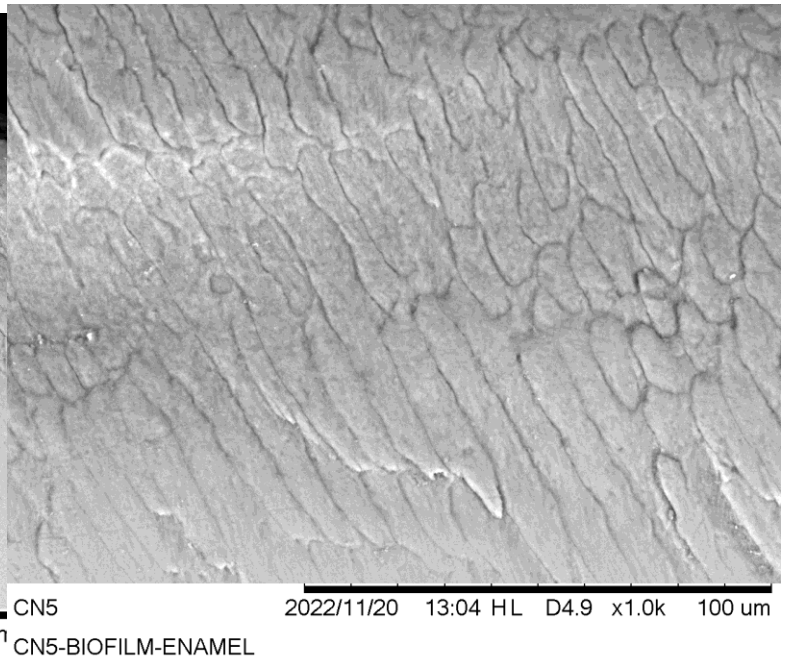
CN4



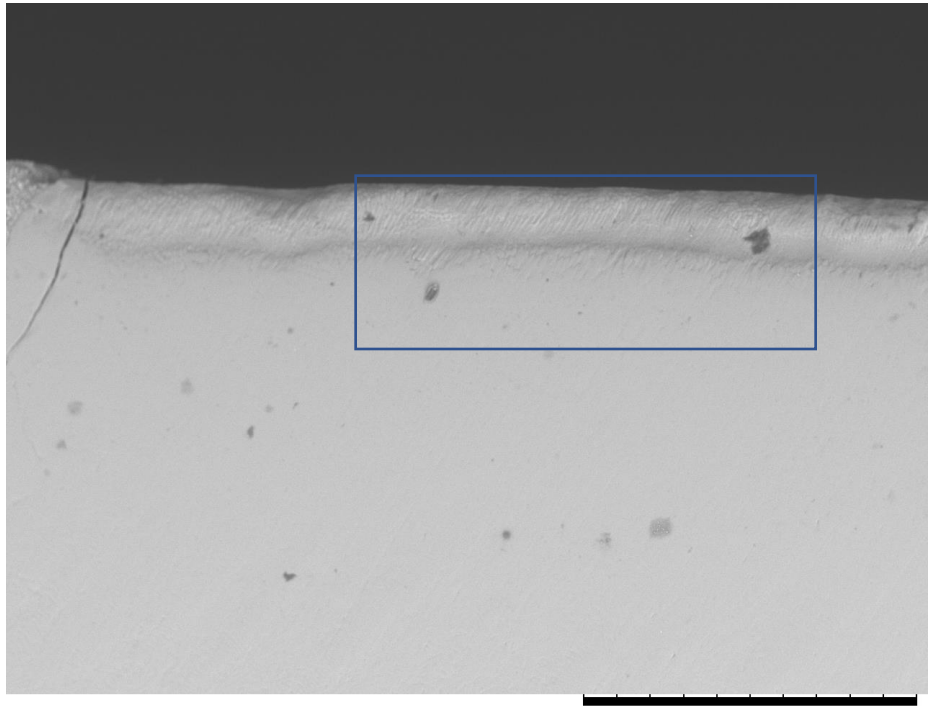
CN

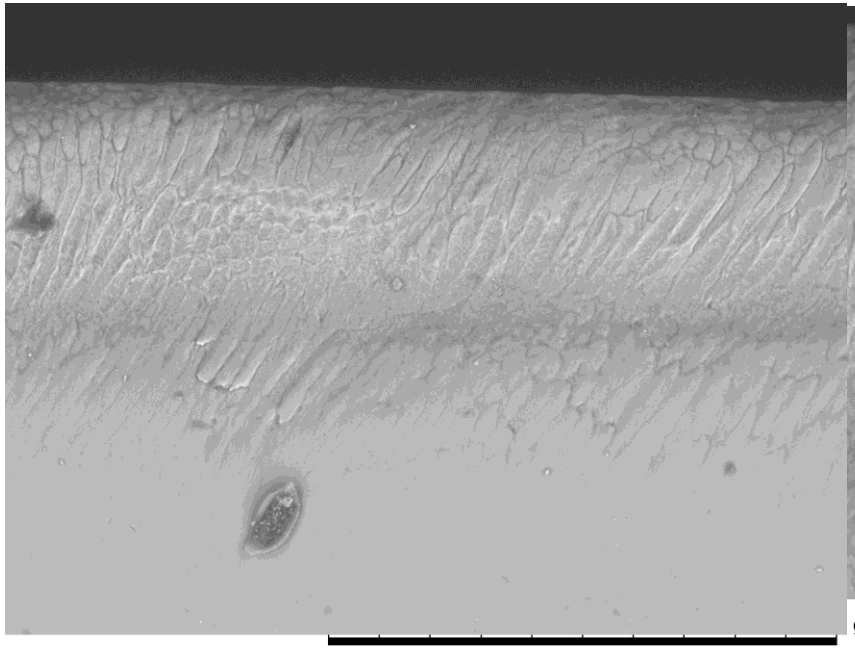

CN5 2022/11/20 13:09 HL D4.9 x120 500 um
CN5-BIOFILM-ENAMEL

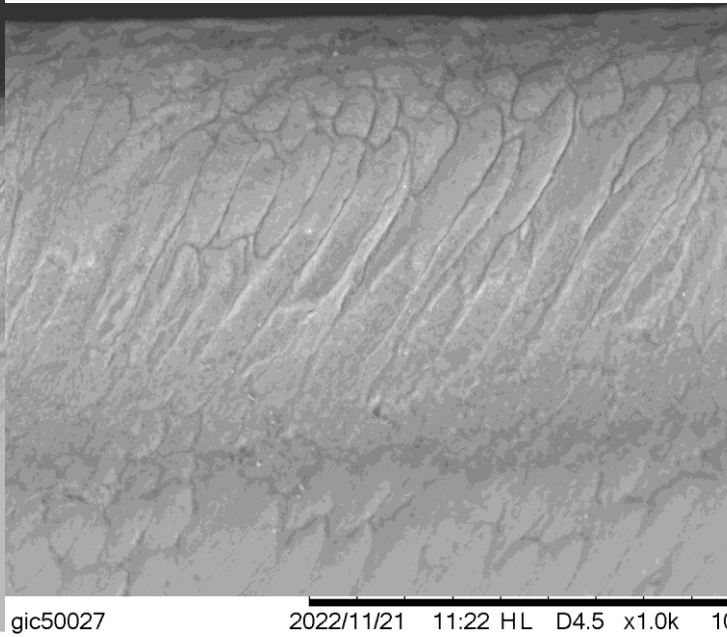

CN5 2022/11/20 13:02 HL D4.9 x500 200 un
CN5-BIOFILM-ENAMEL

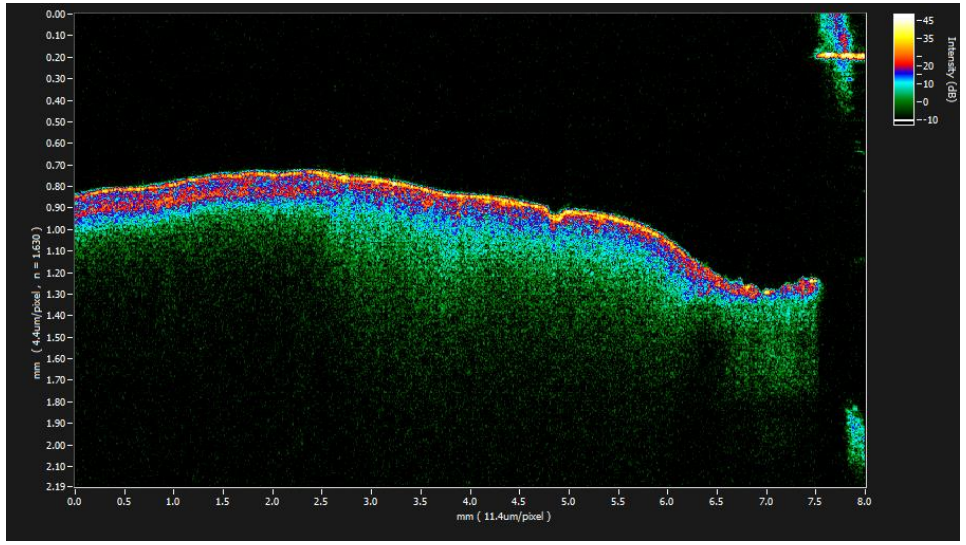

CN5 2022/11/20 13:04 HL D4.9 x1.0k 100 um
CN5-BIOFILM-ENAMEL

CN

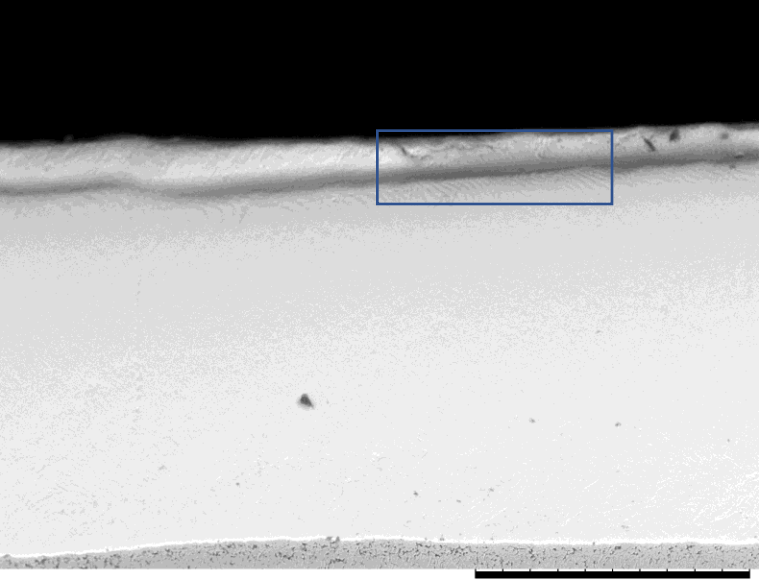

gic50025 2022/11/21 11:12 HL D4.3 x120 500 um
gic5_bioilm

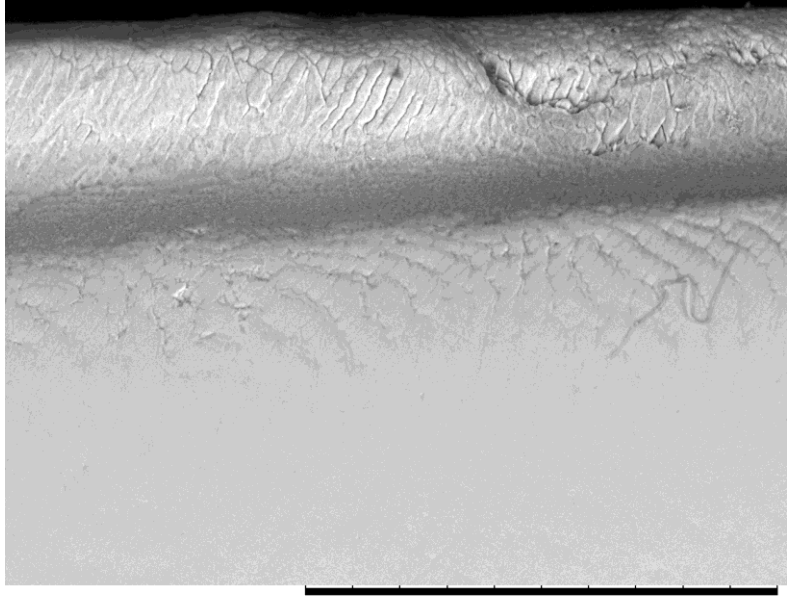

gic50026 2022/11/21 11:15 HL D4.5 x500 200 um
gic5_bioilm

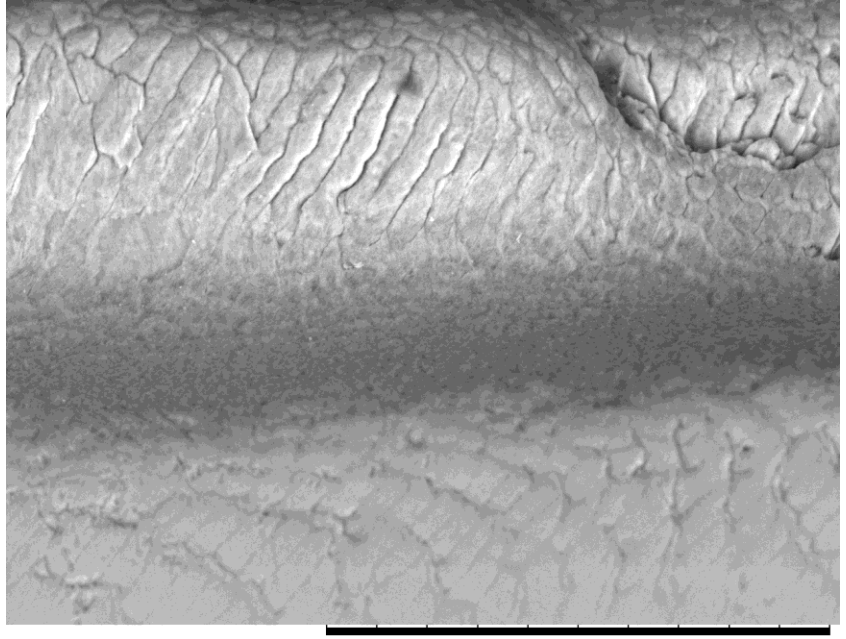

gic50027 2022/11/21 11:22 HL D4.5 x1.0k
gic5_bioilm

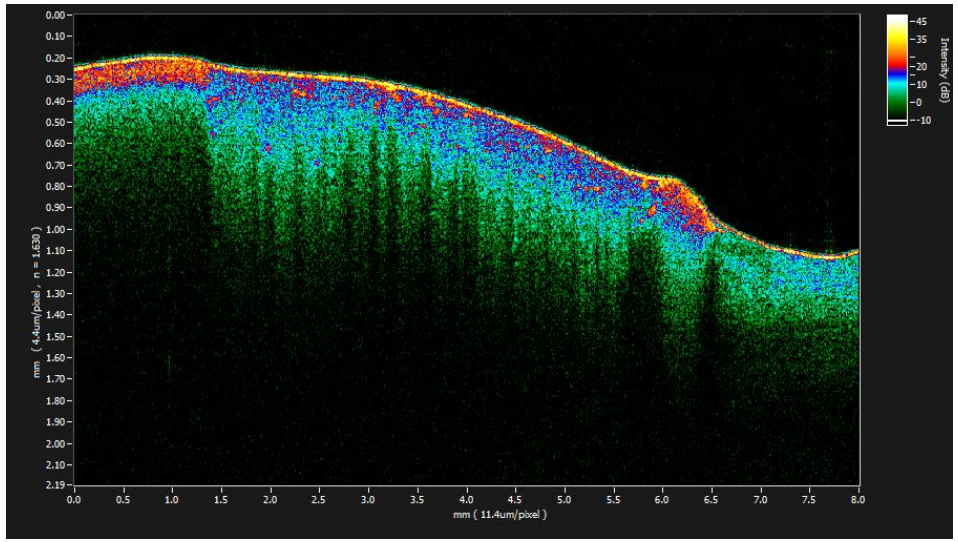

mm (4.4um/pixel , n = 1.630)
mm (11.4um/pixel)
Intensity (dB)

GIC


SUREFIL30036 2022/11/21 14:06 HL D5.4 x120 500 um
SUREFILLBIO

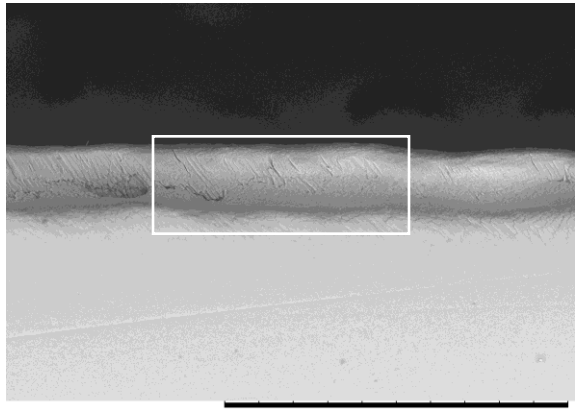

SUREFIL30037 2022/11/21 14:08 HL D5.7 x500 200 um
SUREFILLBIO

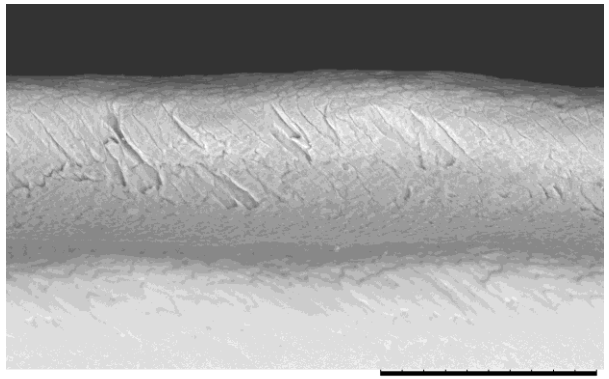

SUREFIL30038 2022/11/21 14:13 HL D5.8 x1.0k 100 um
SUREFILLBIO

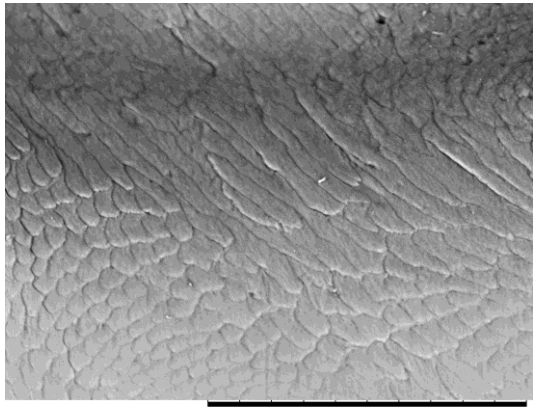

mm (4.4um/pixel , n = 1.630)
mm (11.4um/pixel)
Intensity (dB)

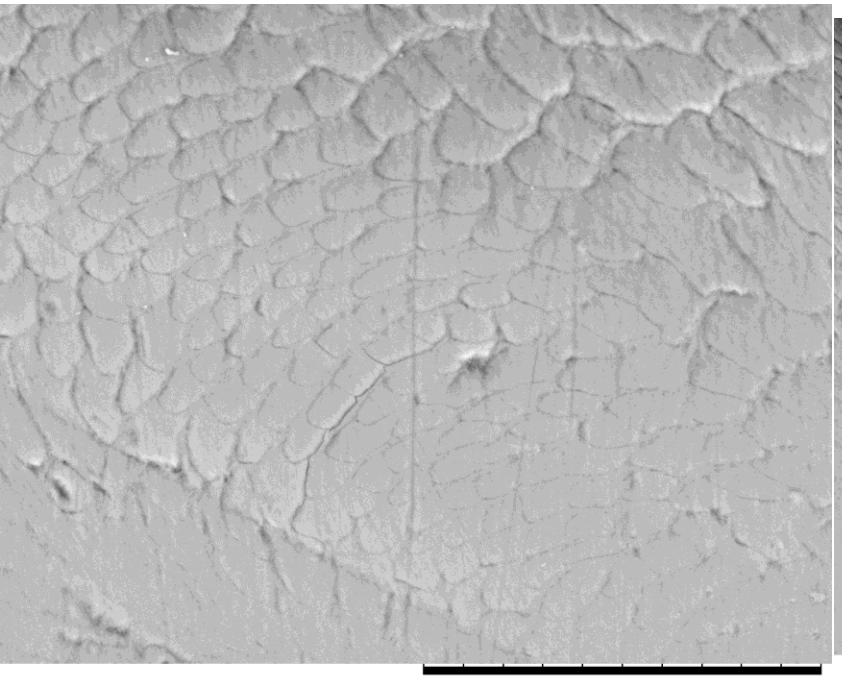
SUREFILL

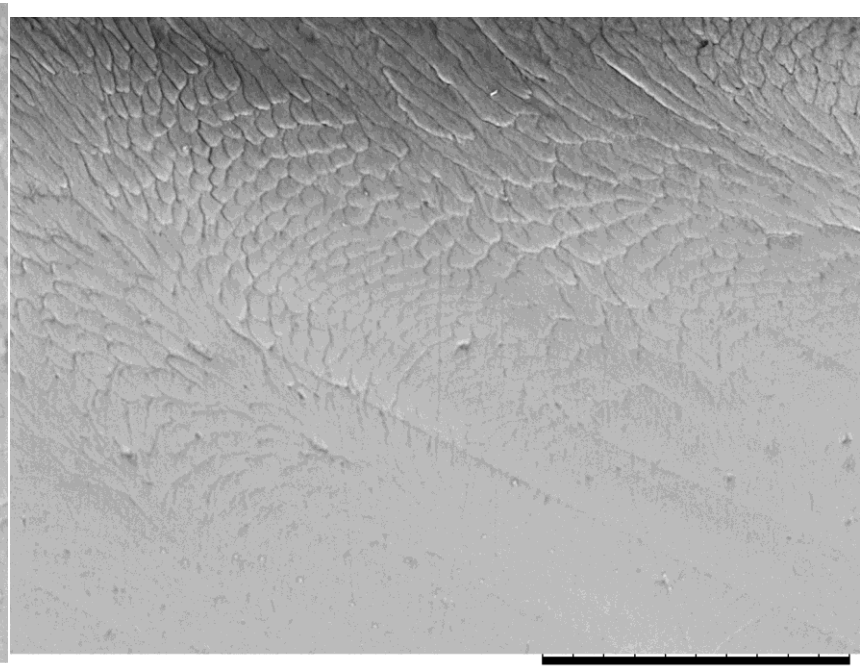
biofilm- SEM

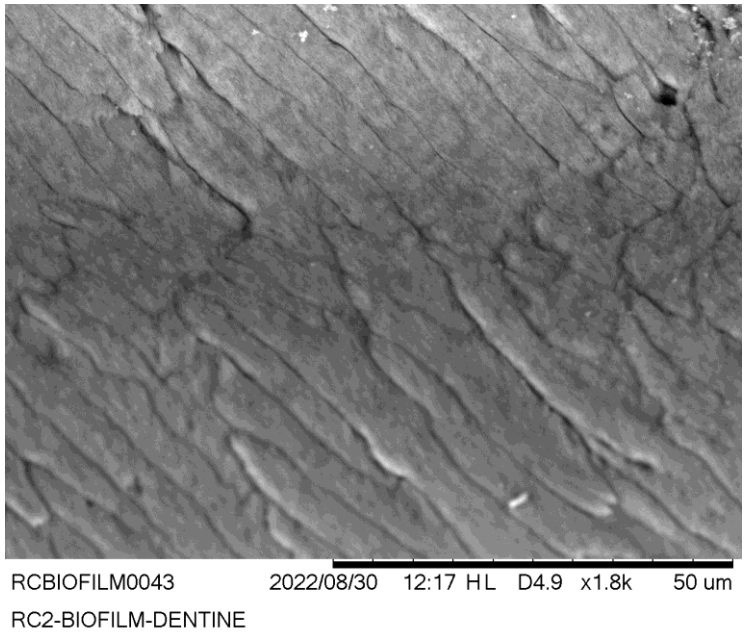

BIOFILM
2022/08/22 14:21 HL D4.7 x200 500 um
RC2-BIOFILM


BIOFILM
2022/08/22 13:55 HL D4.7 x600 100 um
RC2-BIOFILM


RCBIOFILM0042
2022/08/30 12:14 HL D4.9 x1.0k 100 um
RC2-BIOFILM-DENTINE

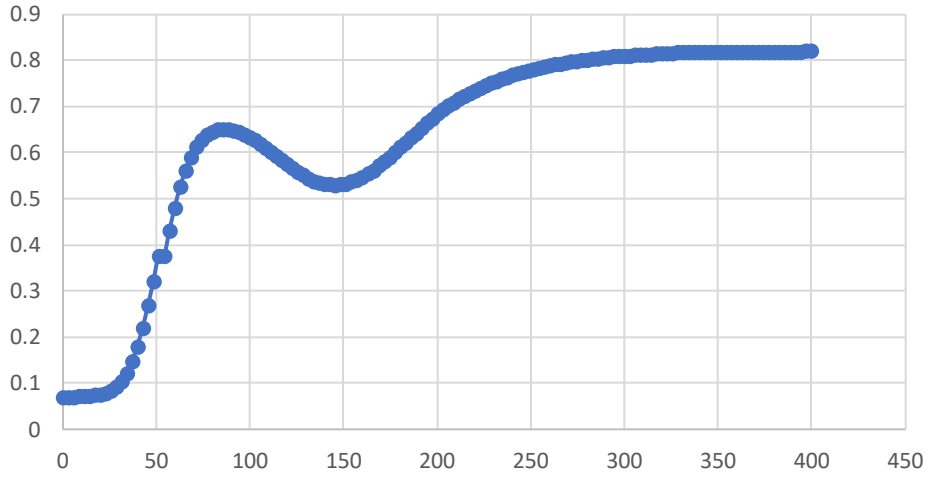

BIOFILM0046
2022/08/30 12:23 HL D4.8 x1.5k 50 um
2-BIOFILM-DENTINE


RCBIOFILM0045
2022/08/30 12:20 HL D4.9 x600 100 um
RC2-BIOFILM-DENTINE

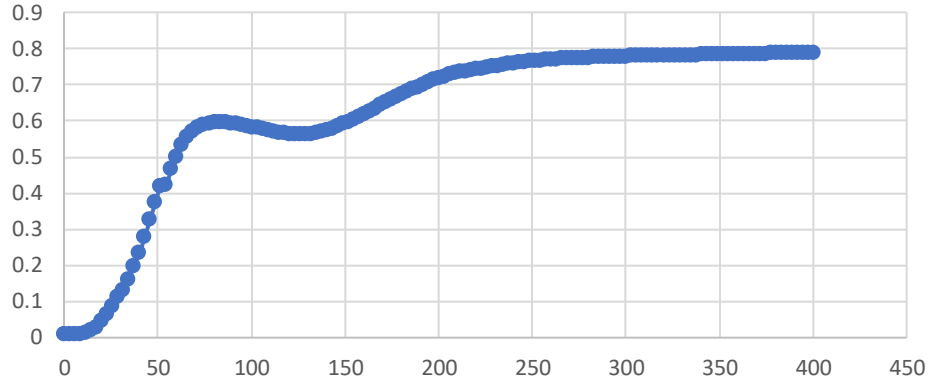

RCBIOFILM0043
2022/08/30 12:17 HL D4.9 x1.8k 50 um
RC2-BIOFILM-DENTINE

Micro CT results

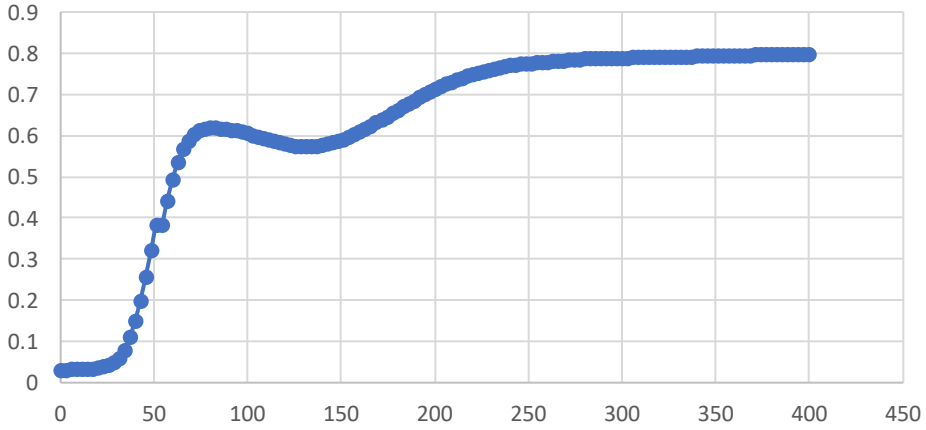
SU-1



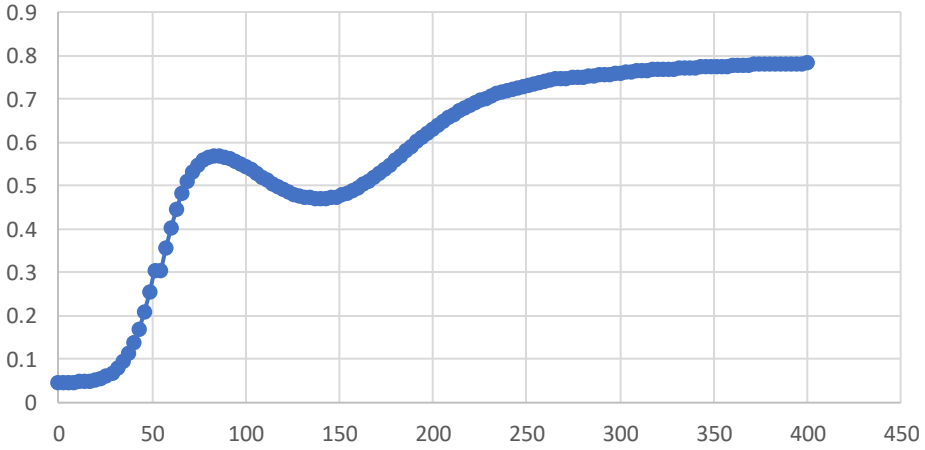
Average CN



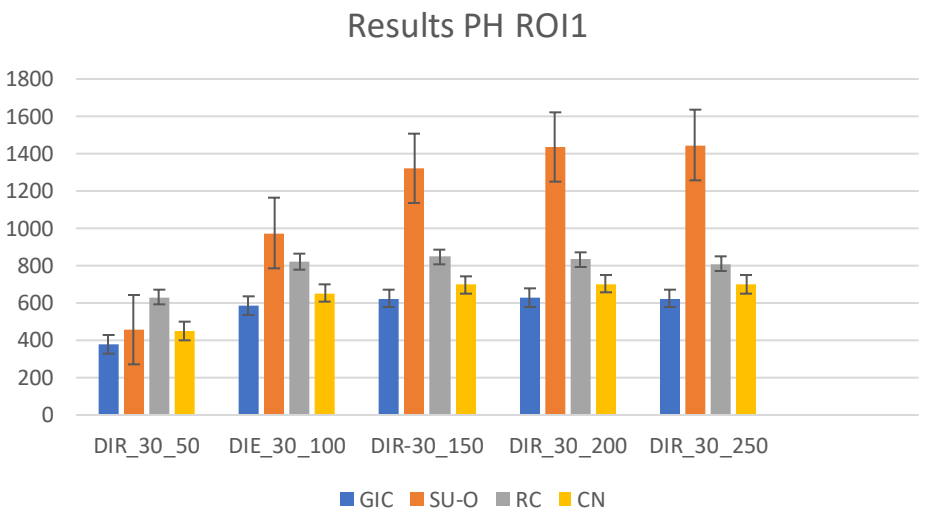
GIC

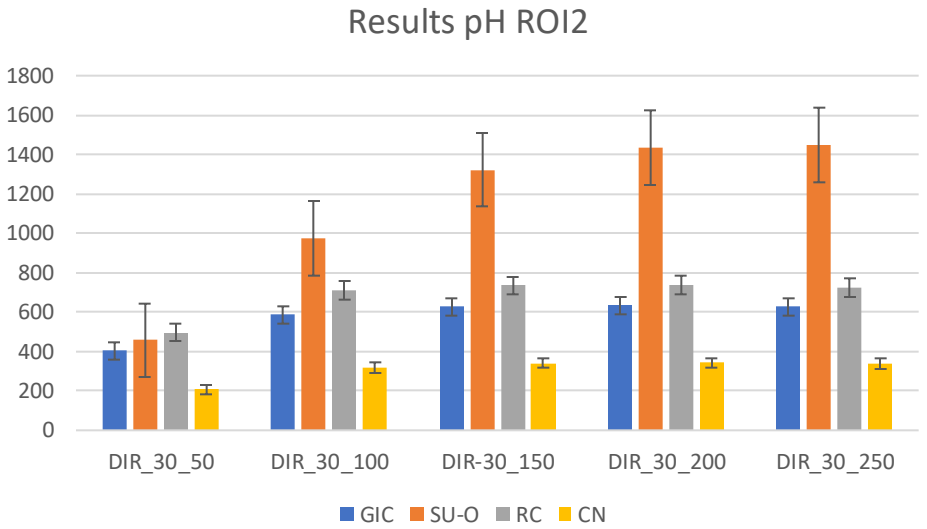


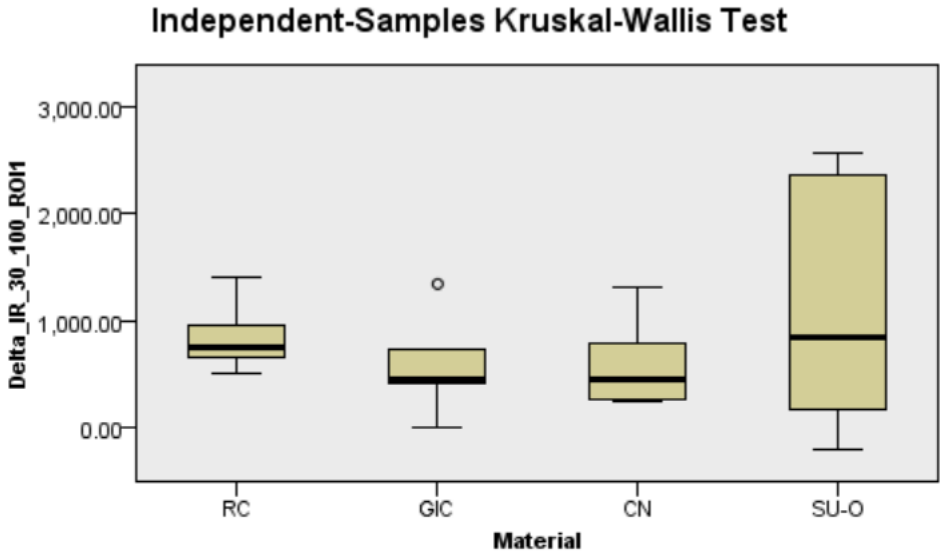
AVERAGE lesion depth for Biofilm-2ry caries model

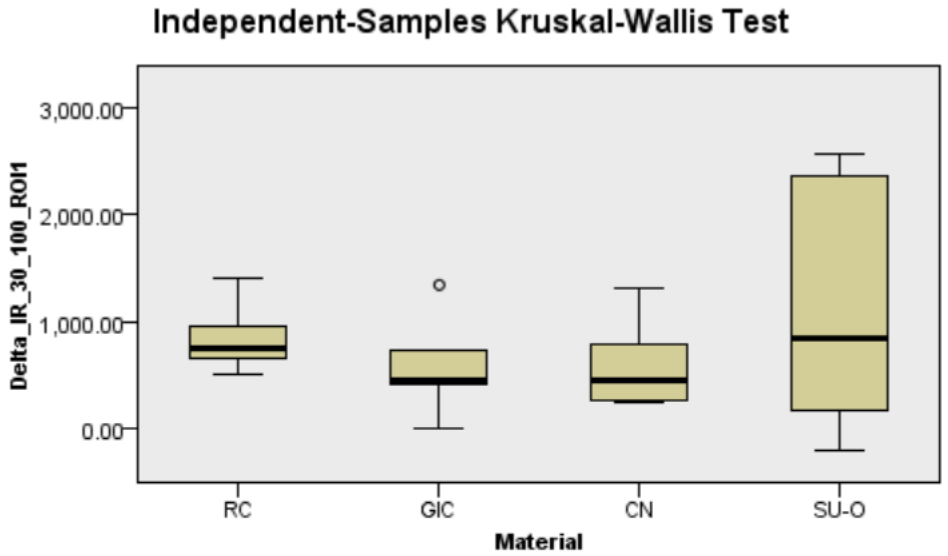


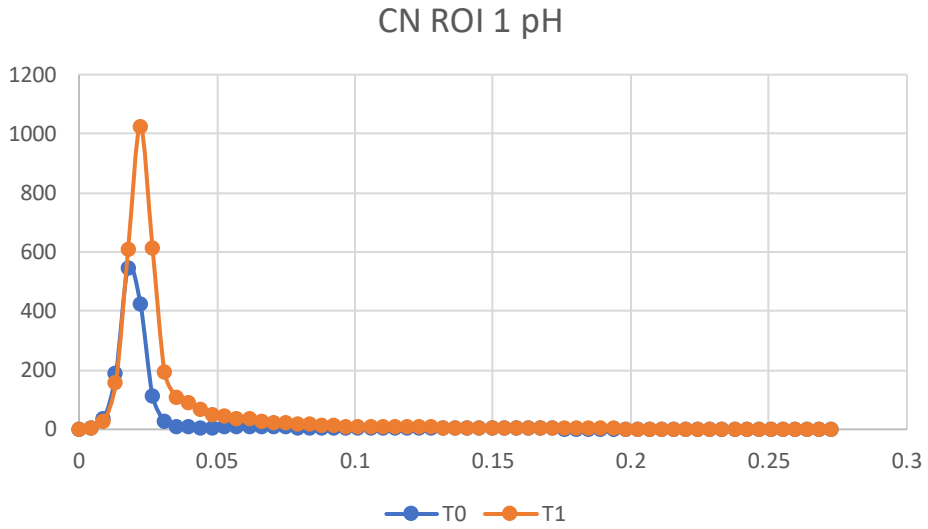
pH cycling results

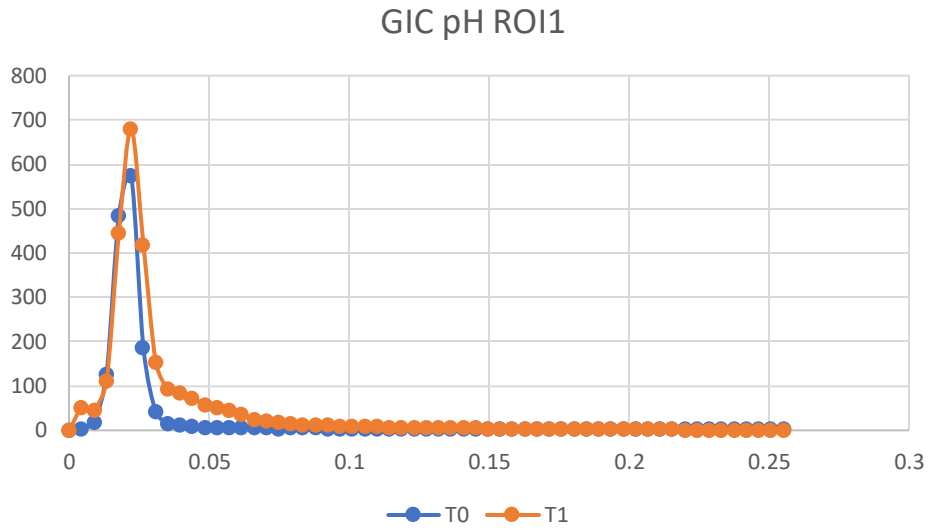


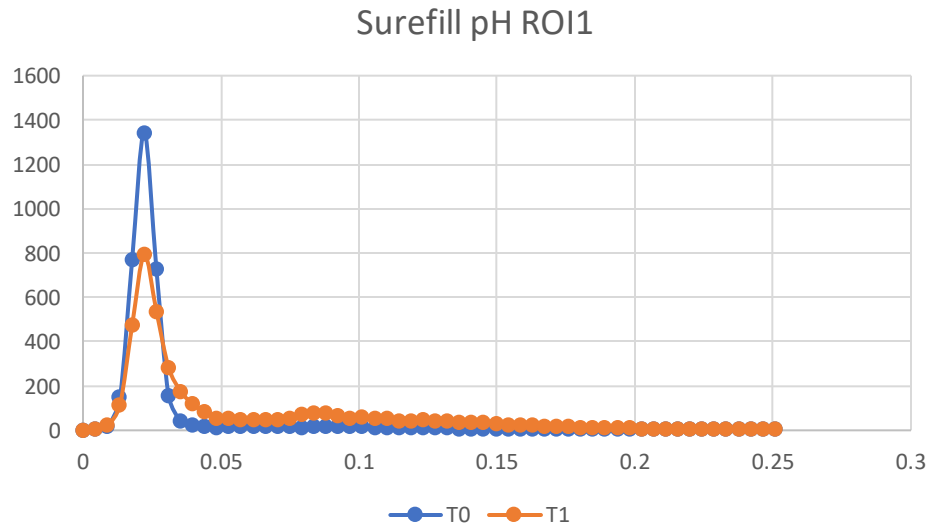


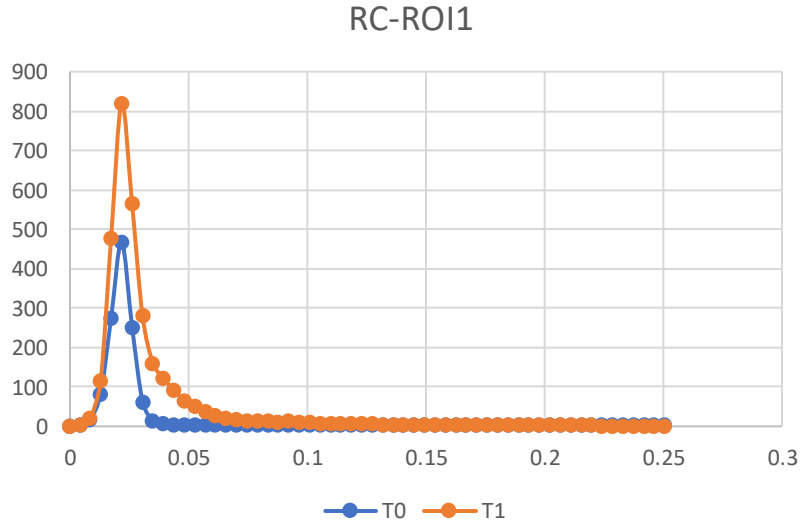




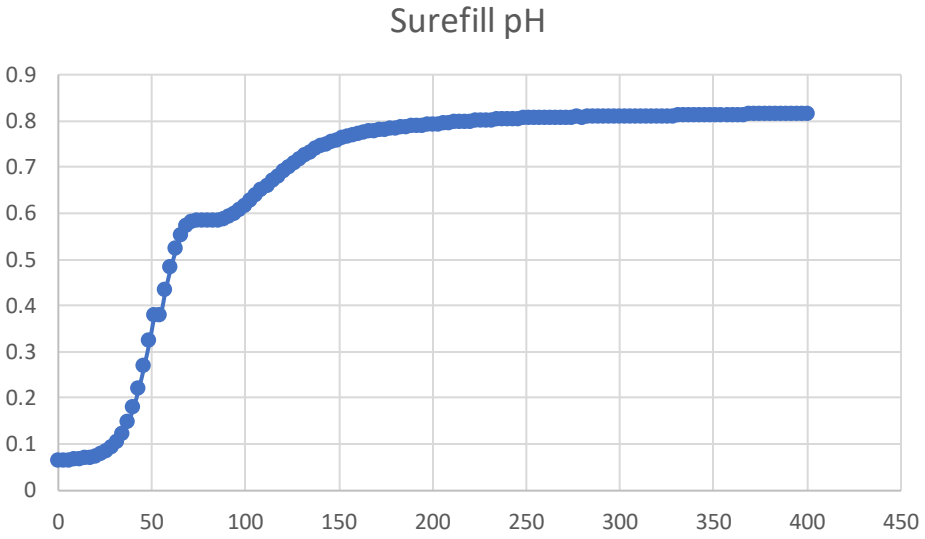

CN ROI 1 pH
1200
1000
800
600
400
200
0
0
0.05
0.1
0.15
0.2
0.25
0.3
T0
T1

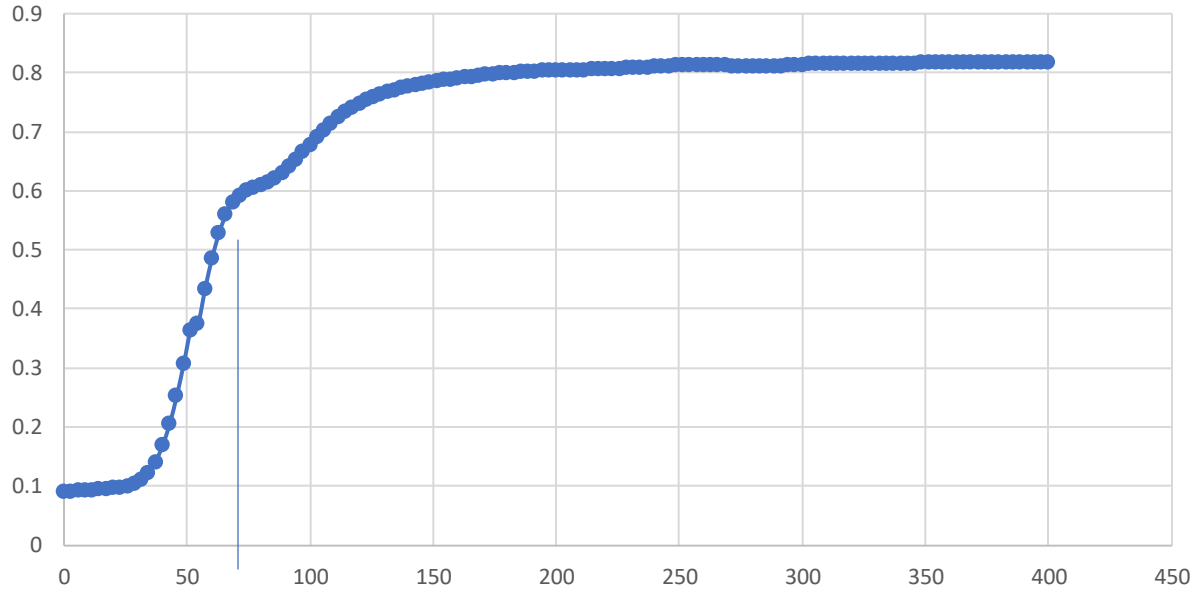

GIC pH ROI1
800
700
600
500
400
300
200
100
0
0
0.05
0.1
0.15
0.2
0.25
0.3
T0
T1

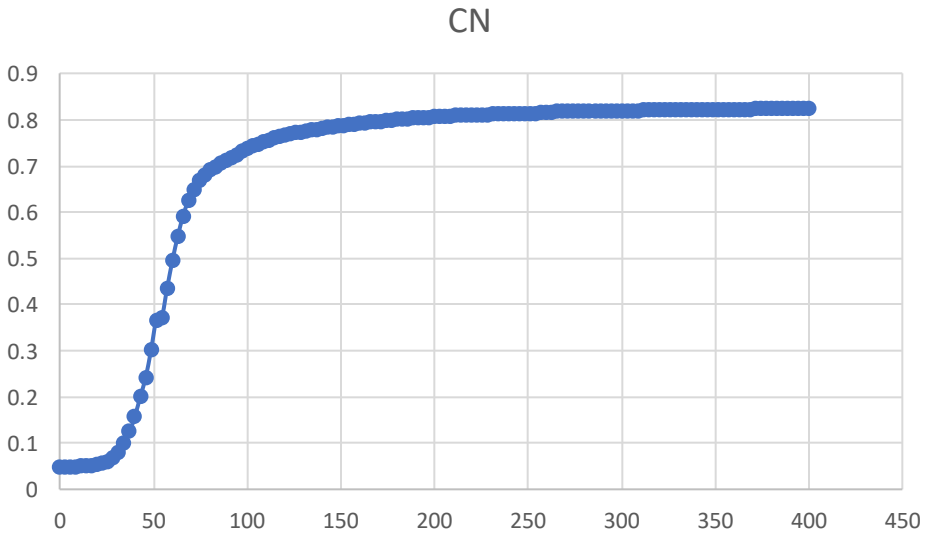

Surefill pH ROI1
1600
1400
1200
1000
800
600
400
200
0
0
0.05
0.1
0.15
0.2
0.25
0.3
T0
T1

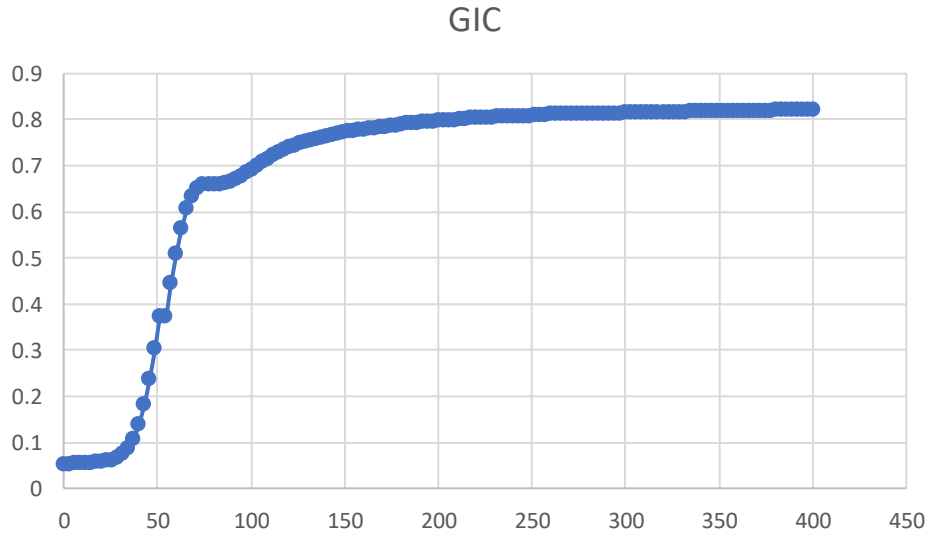

RC-ROI1
900
800
700
600
500
400
300
200
100
0
0
0.05
0.1
0.15
0.2
0.25
0.3
T0
T1

Average Lesion depth for pH cycling RC









Conclusions

1. CN Showed caries inhibitory effect that was not statistically significant from that of conventional GIC,

2. The biofilm secondary caries model was able to differentiate the caries inhibitory effect of different material categories while no difference was observed in the pH cycling model

1. GIC secondary caries inhibitory effect was more pronounce directly at the restorations margin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