Biomimetic texturing as an effective antifouling solution

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Outline

- The problem of biofouling
- Traditional methods to prevent fouling
- Inspiration from nature
- Bioinspired design – the Brill fish, *Scophthalmus rhombus*
- Production methods
- Testing of designed micro-textures
- Results

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The problem of biofouling

Seconds to minutes | Minutes to hours | Hours to days | Days to months | Months to years

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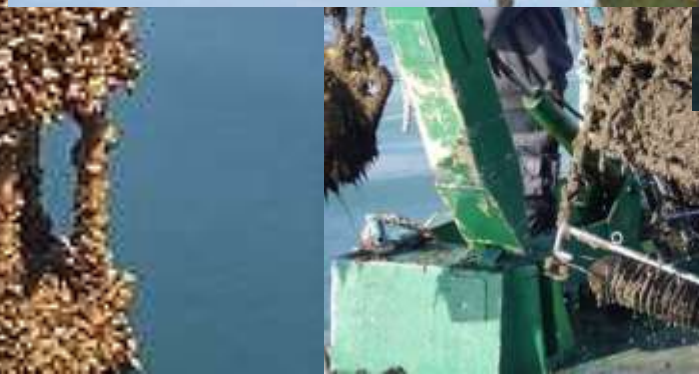

Traditional Methods

- Silicone Polymer
- Antifouling Paints
- Copper
- PVDF Resin
- Fouling Release Coatings
- TBT-SPC
- Fluorinated Ethylene Propylene
- Sol Gel Coatings
- Hydrophobic/Hydrophilic Coatings

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Inspiration from nature

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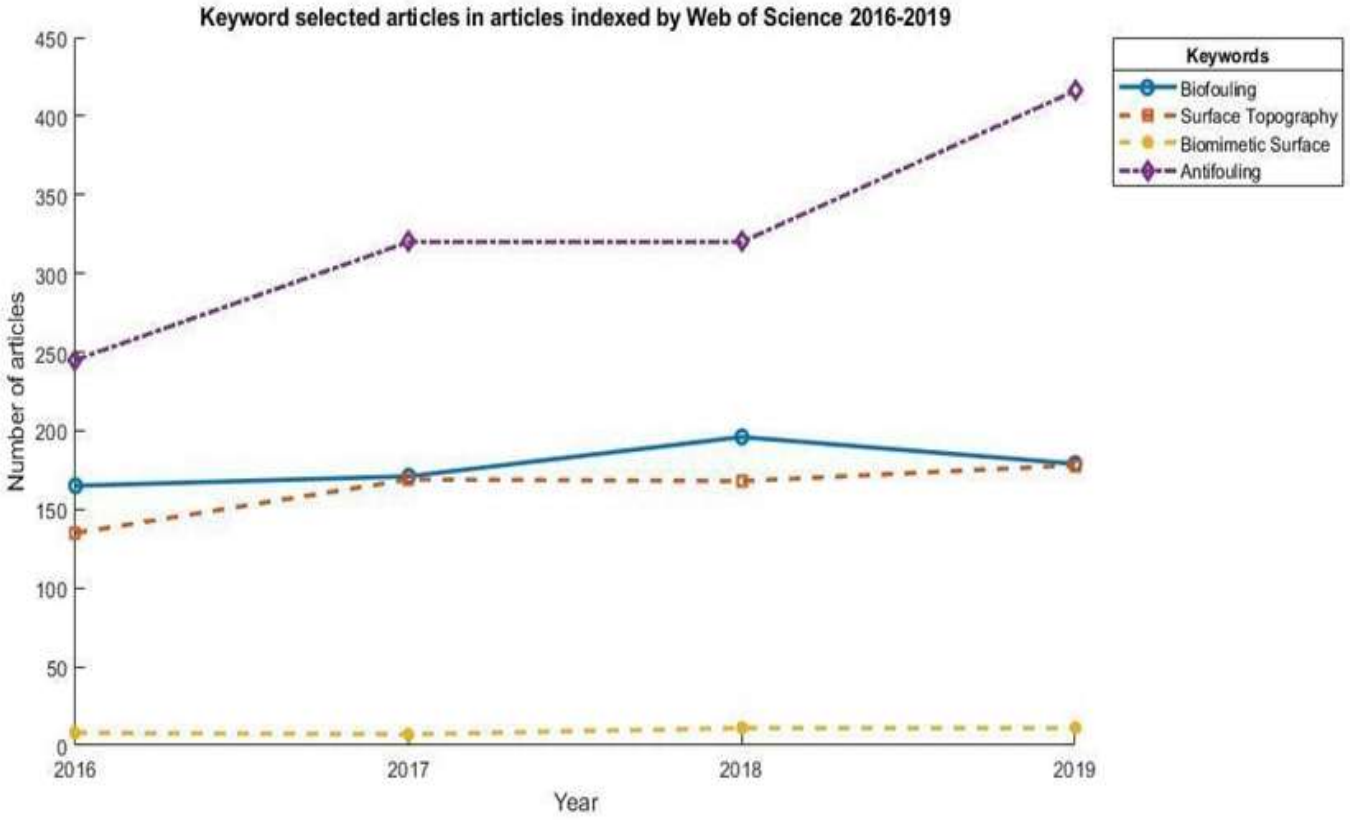

Int J Mol Sci. 2020 Jul 17;21(14):5063.

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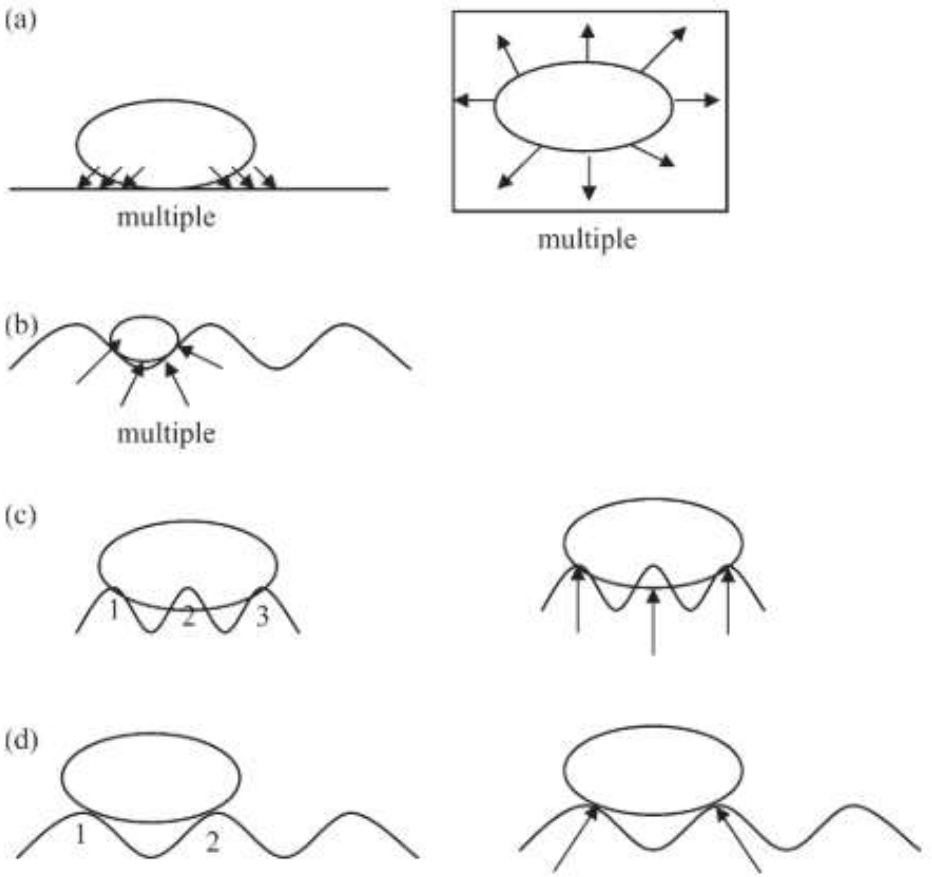
Why bioinspired surfaces?



Biofouling, 2006; 22(1): 55 – 60

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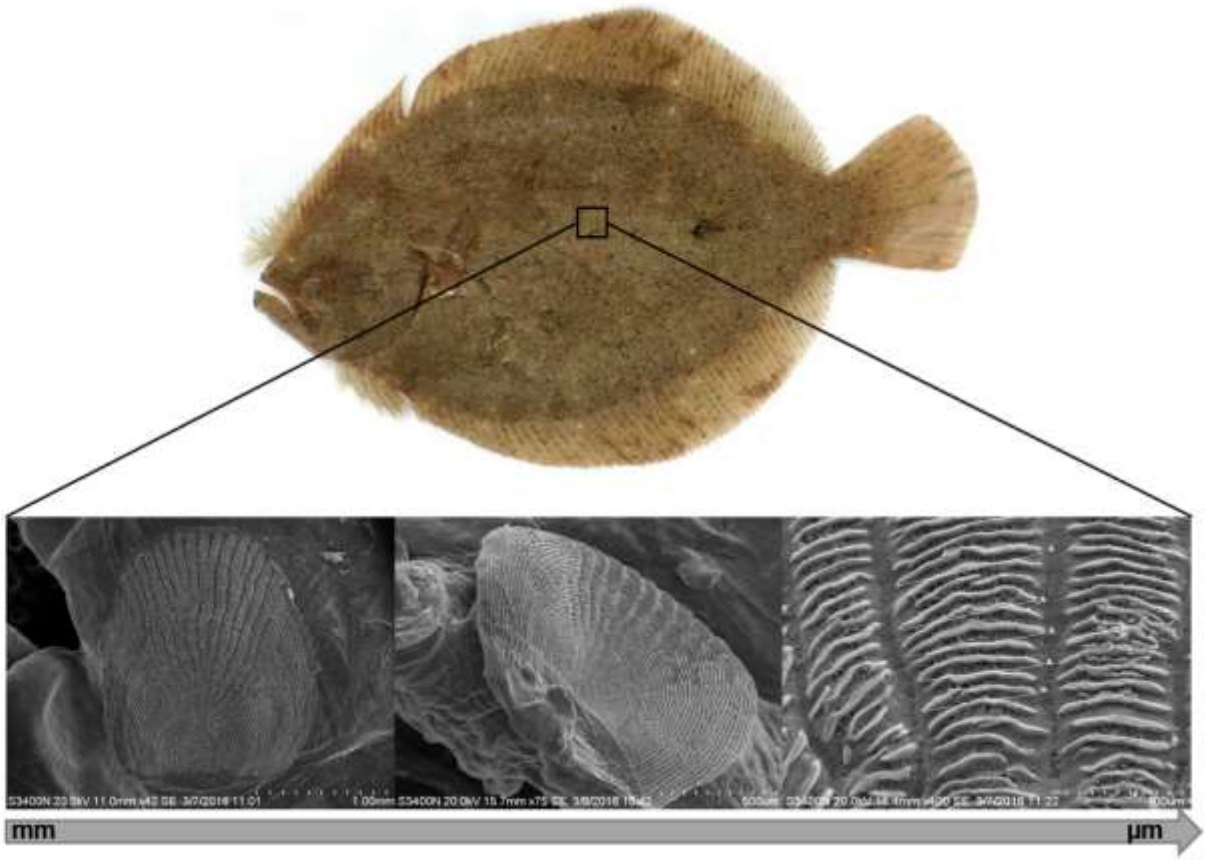
Marine design – the Brill fish (*Scophthalmus rhombus*)



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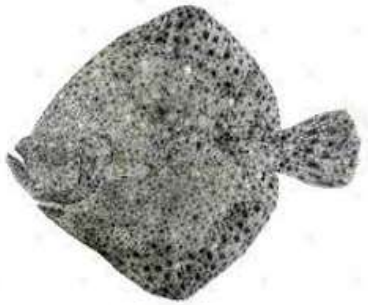
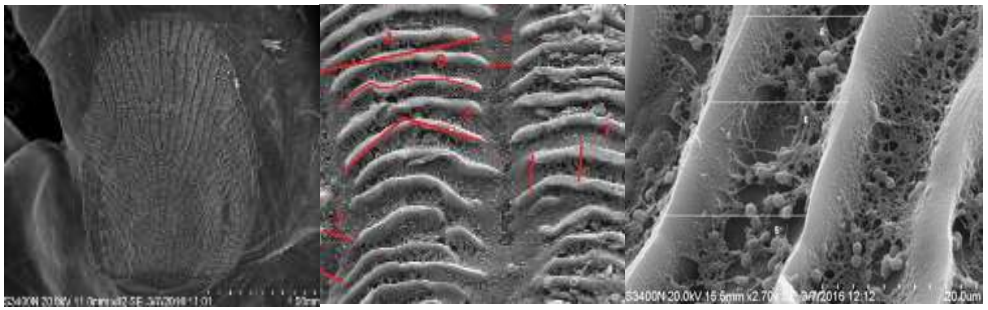
Production of bioinspired materials

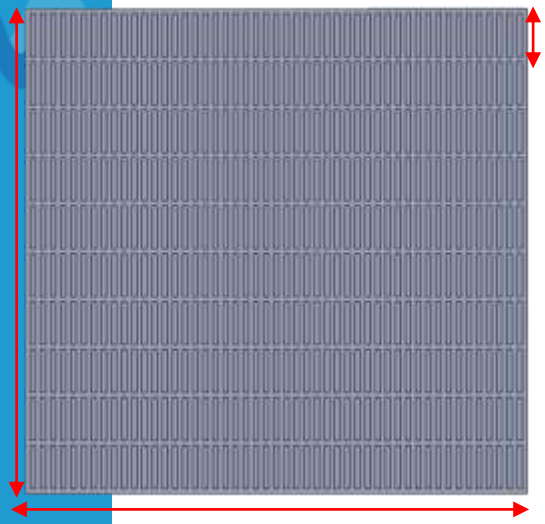


1. Inspiration from nature, the Brill fish was characterized for its antifouling potential.

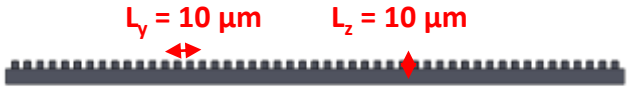


2. Characterization of topography using SEM.

A: 74.84 µm
B: 81.07 µm
C: 143.08°
D: 11.7 µm
E: 16.6 µm
F: 15.8 µm



5. Production of micro-textures using 2-photon 3D printing.



3. Micro-texture design in SolidWorks 2017.

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3D Printing – Two photon polymerization (2PP)

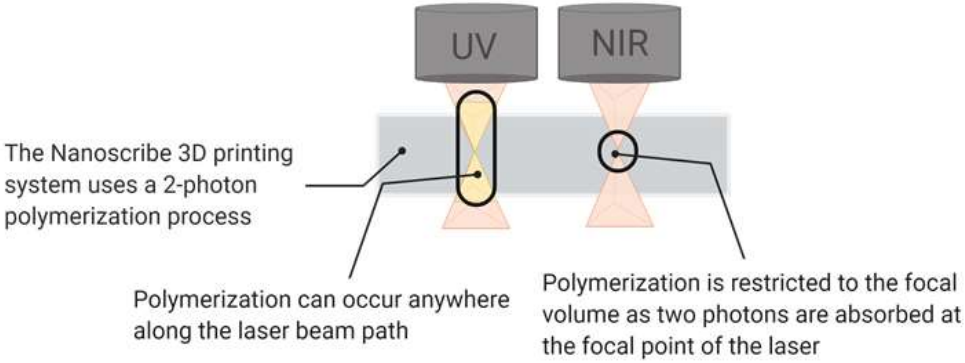

Figure 2. Nanoscribe 2-photon 3D printer

Figure 3. 3-D printed micro-texture taken using Keyence 3D light microscopy

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Table 1. Summary of designed micro-textures

Label	Description
T1	Raised Bar Array (RBA) with sharpened edges and Ly dimension of 10 µm
T2	Raised Bar Array (RBA) with rounded edges and Ly dimension of 10 µm

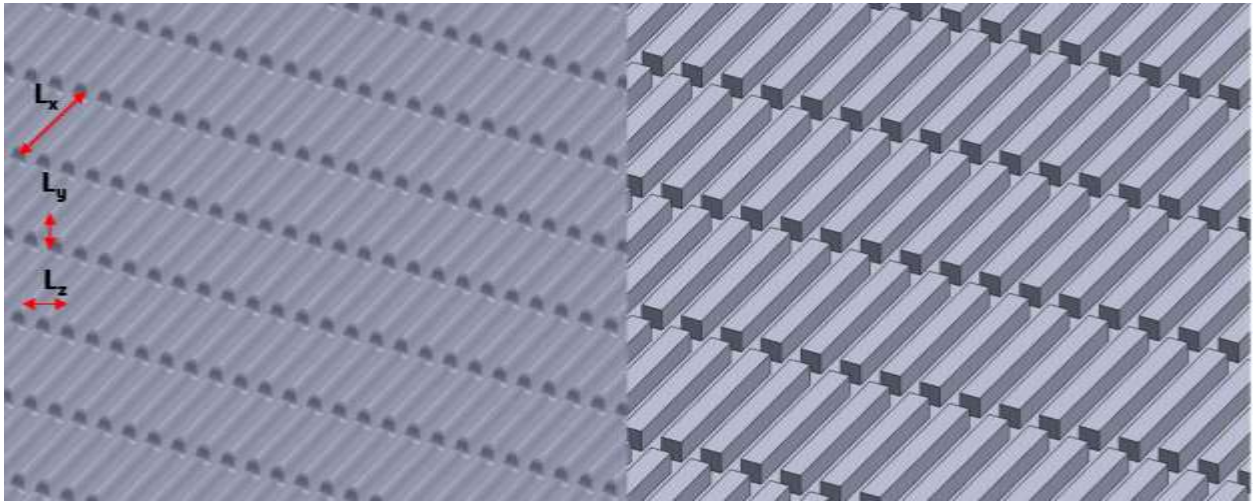

Figure 1. Outline sketch of Raised Bar Array (RBA) micro-texture for feature height L_y = 10 µm and L_z = 10 µm

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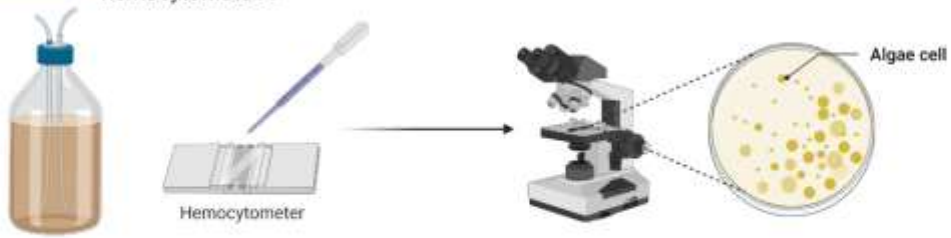
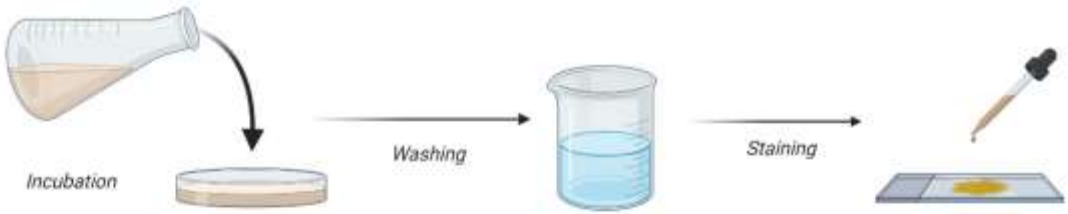
Testing of designed micro-textures

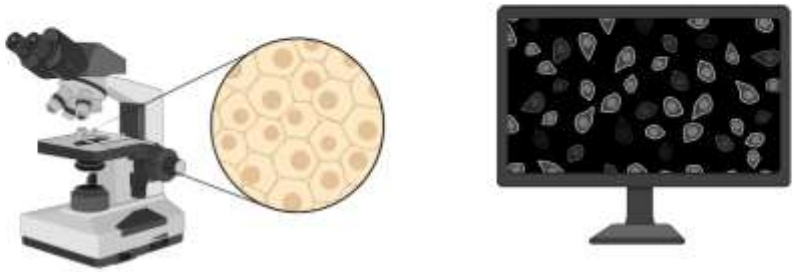
Step 1 Cell numbers were estimated by counting in the central area of an improved Neubauer hemocytometer. .



Step 2 Microtextures were immersed in 10 mL culture suspension for 3 hr.



Step 3 Colonization of microtextures was observed using light microscopy and ImageJ image processing software.



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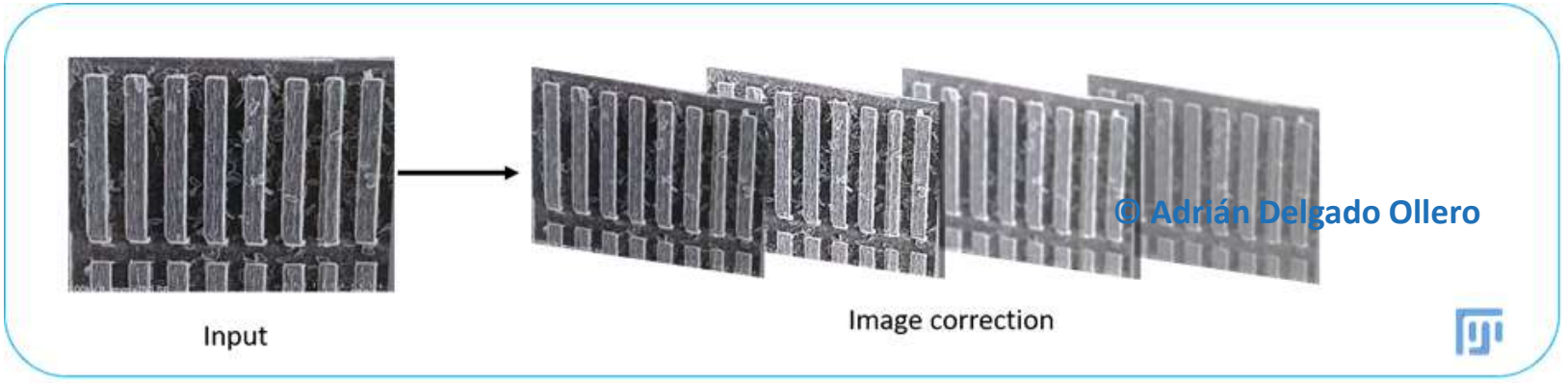
Statistical analysis using ImageJ



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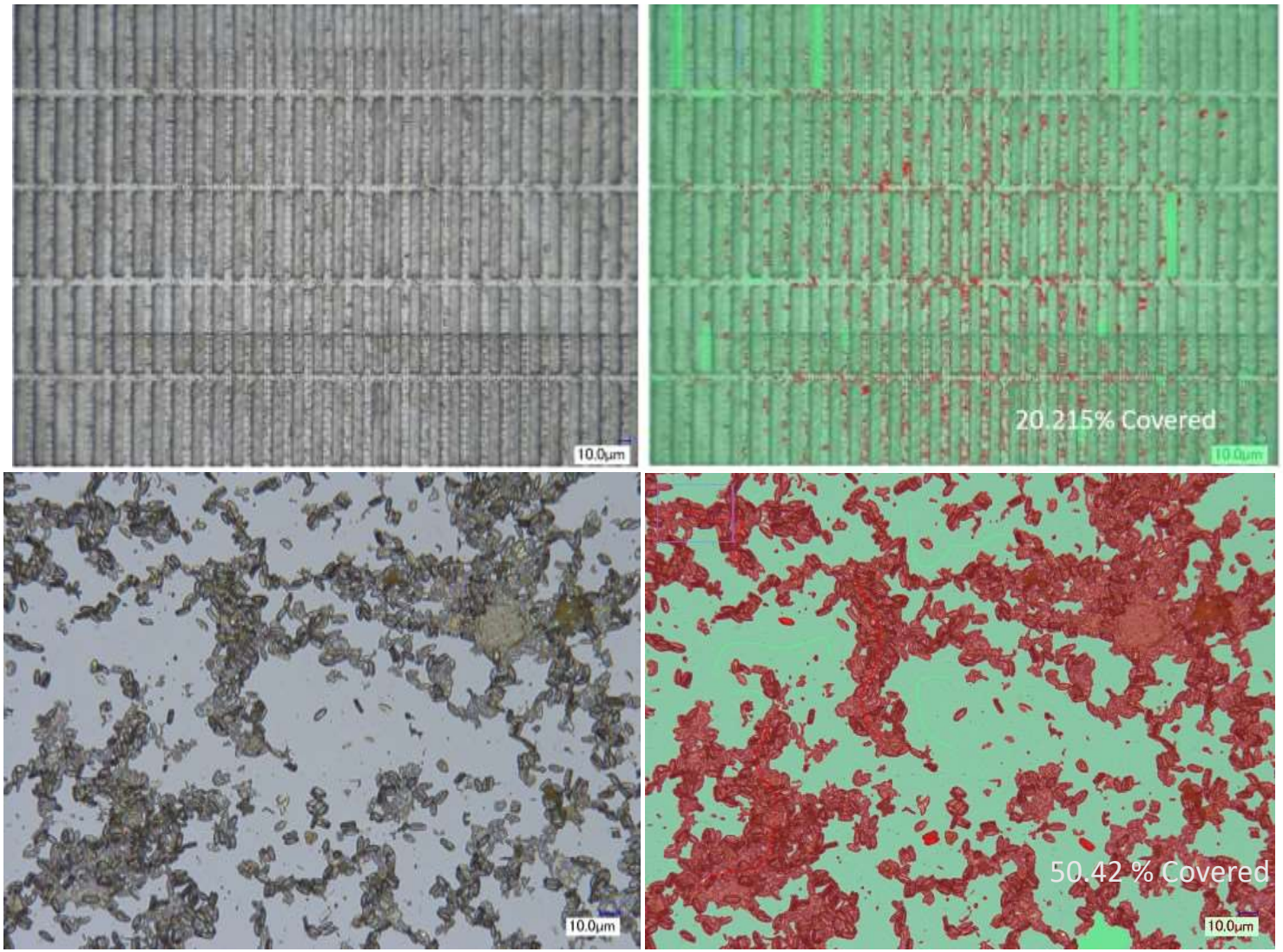
Results



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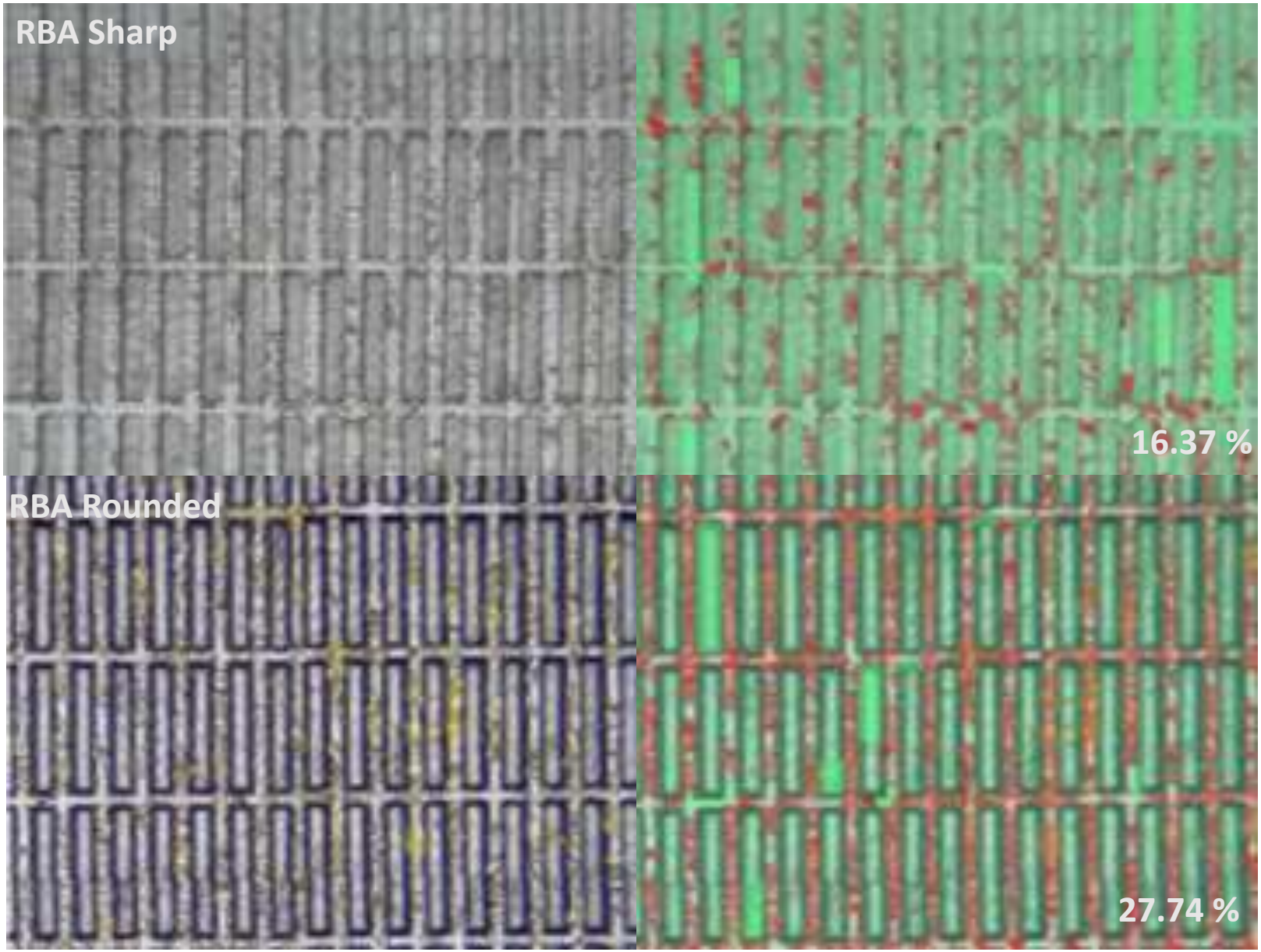

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Results

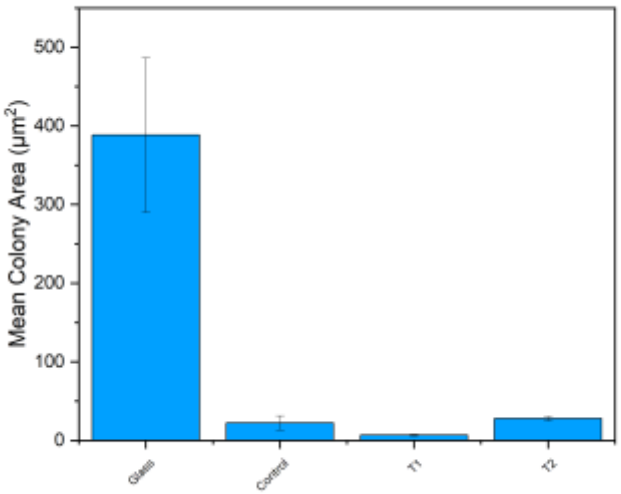

Figure 2. Mean colony area (µm^2) of N. ovalis cells on produced textured surfaces. Standard error was used to produce error bars (n = 3)

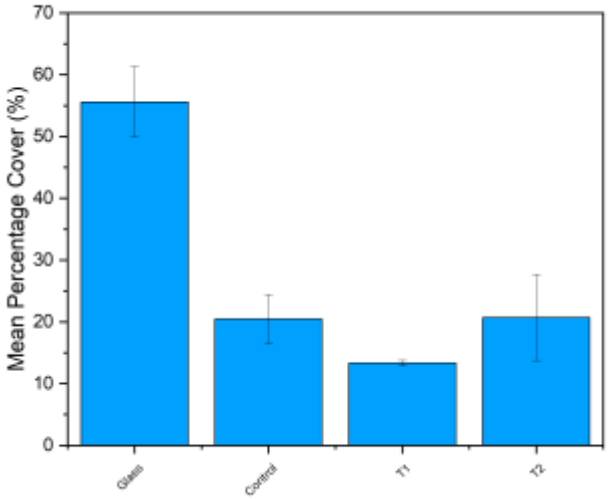

Figure 3. Mean biofilm cover (%) of *N. ovalis* cells on produced textured surfaces (n = 3)

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Thank you for your attention!

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