imprimer la lumière

bacterial luminescence as a 3D-printed spiral micro-architecture

Mette Ramsgaard Thomsen, Martin Tamke, Guro Tyse & Aurélie Mosse – March 23, 2023

• 3D printing • architectural materiality • architecture • bacteria • biodesign • bio-digital crafting • bioluminescence • bioprinting • design • living matter • micro-architecture • vibrio fischeri

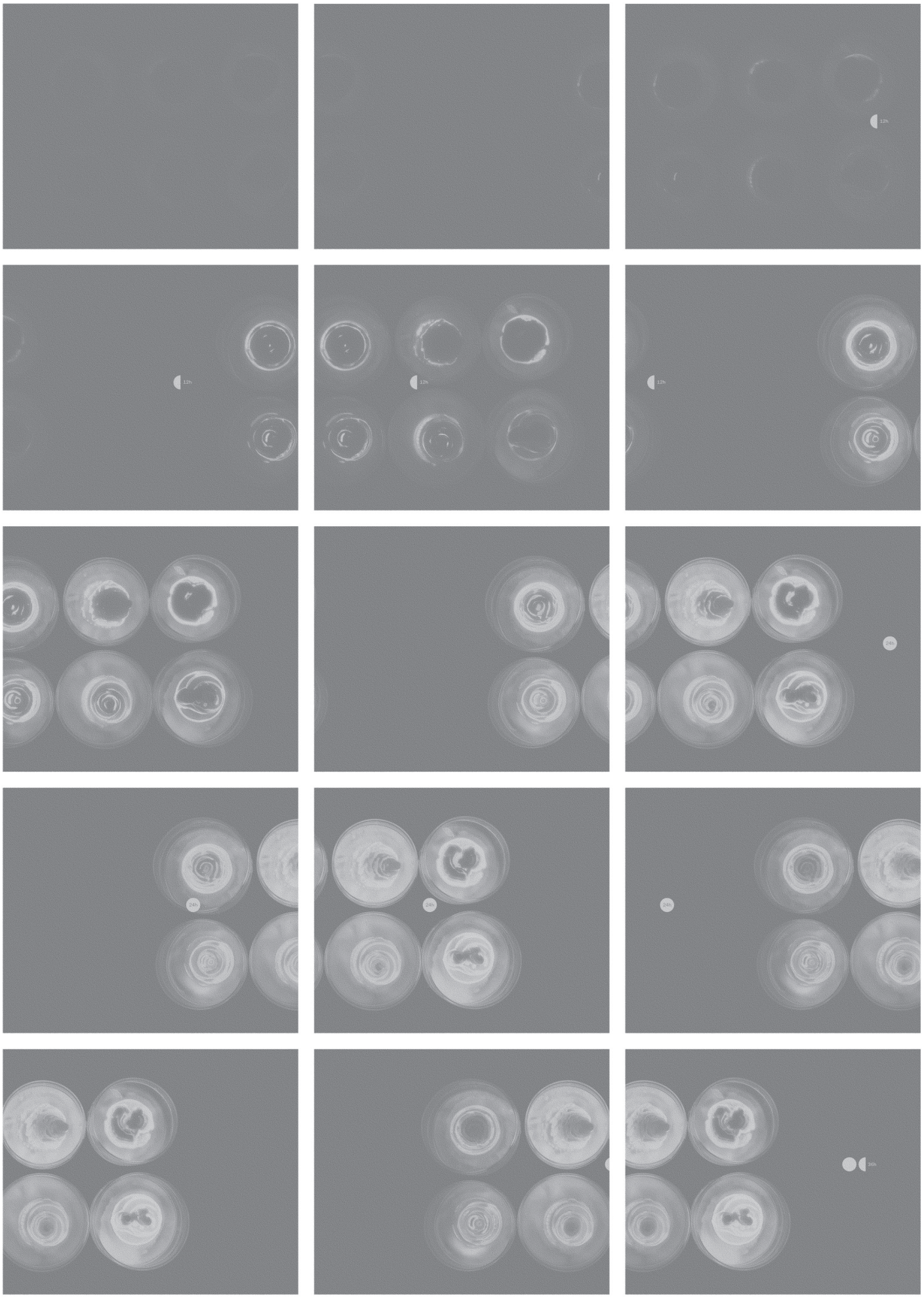
Modern biology is in the process of reinterpreting our body. Where the body was once considered an autonomous, controlled and essentially closed organism, we are now understood as participating in an ecology of commensal, symbiotic and pathogenic microorganisms. It is believed that we are inhabited by 10–100 trillion microbial cells (Ursell et al. 2012; Yang 2012). This radical rethinking of our body has existential consequences (Helmreich 2016). What is it to be human, how is the body functioning, and what does health and will mean in such an open interacting system? *Imprimer la lumière* asks: if architecture is based on a humanism—that is, an understanding of being human—how will such a new self-understanding create profound differences in how architecture is conceived, shaped, and materialized?

Sitting at the intersection of architecture and textile design practices and underpinned by a design probes approach, the project examines—from a practice-based perspective—the digital crafting of 3D-printed bioluminescent micro-architectures. While bioluminescence is commonly used as a marker in biology and medicine, in the fields of design and architectural it has mainly been investigated as an alternative to public and domestic lighting (Estevez 2007; Chassard 2015; van Dongen 2014, Thomsen 2017). Here we use bacterial luminescence as the means to explore the appropriation of living microorganisms as an architectural materiality, both from a critical and practical perspective.

In terms of fabrication, the project investigates new means by which to design with the light-emitting Vibrio fischeri bacteria through advanced robot-controlled 3D-printing technologies based on the extrusion of an agar-based bespoke nutritive medium. The technological set-up, relying on a collaborative robot and methods supporting the experiments, are discussed in more depth in earlier publications (Tyse et al. 2022; Ramsgaard et al. 2022; Ramsgaard et al. 2021).

Here we share a series of material probes on self-illuminating living micro-architectures, exploring the printability of a nurturing medium for bioluminescent bacteria, and how its formal resolution—its height, thickness, and geometry—affect and control their light performance. In particular, we propose a visual comparison of 3D printed-spiral tower-based variations in time, a typological structure chosen for its ability to channel the water in which the bioluminescent bacteria thrive in.

These micro-architectures are part of a larger study exploring the relationship between the architecture of the 3D-printed nutritive medium and the bacterial propagation throughout this milieu, in other words, how the design of the ecosystem's topology affects the light-emitting metabolism and the perception of their luminescence through time (Thomsen et al. 2021). They also constitute a practice-based ground from which to question and reflect on how architecture can become host for an ecology of species in symbiotic coexistence.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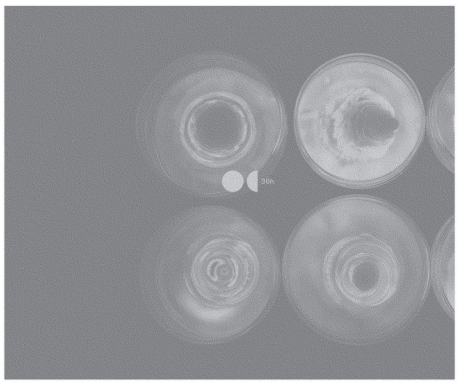
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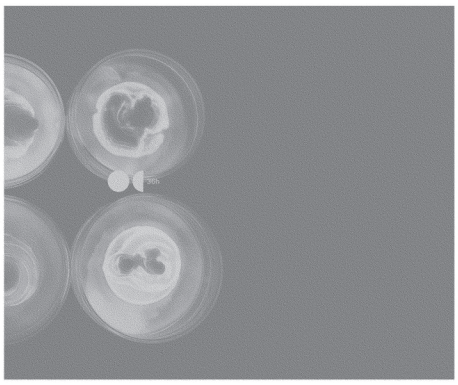
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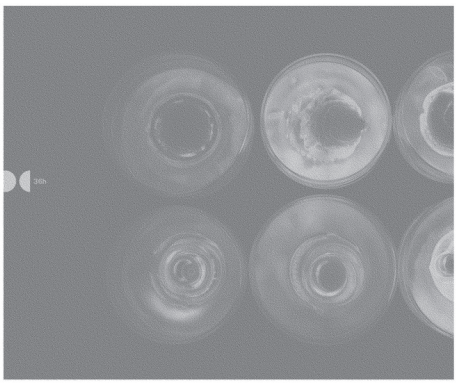
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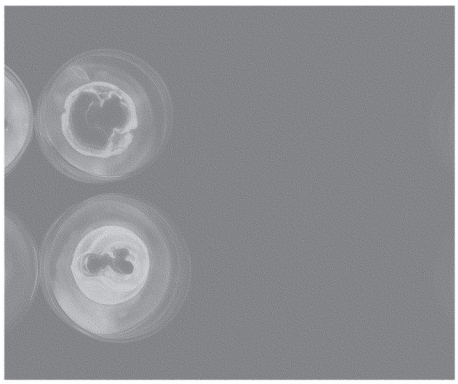
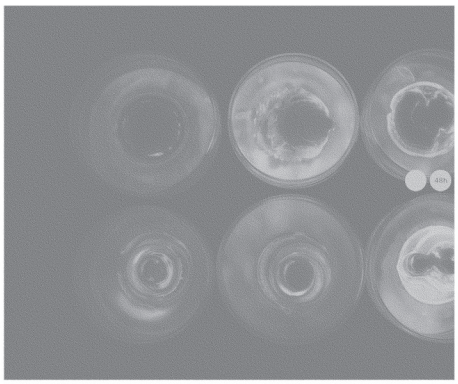
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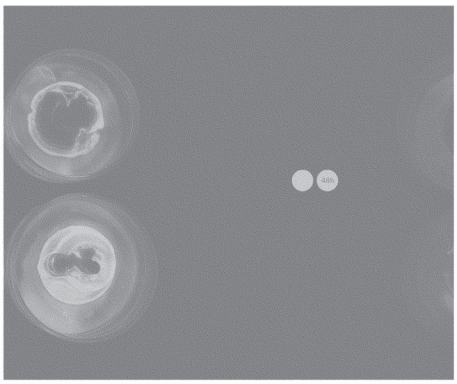
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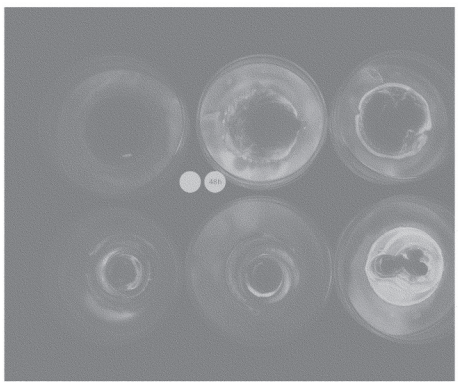
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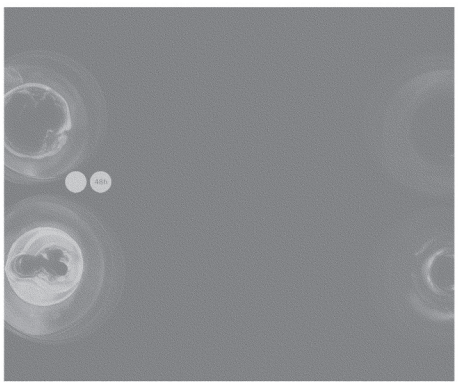
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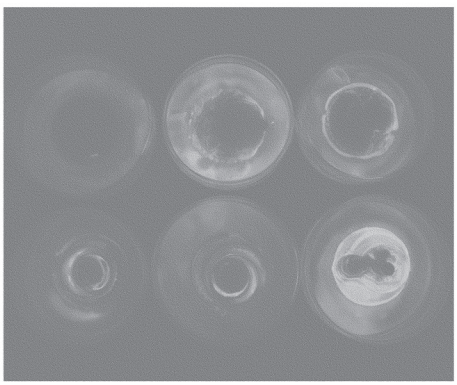
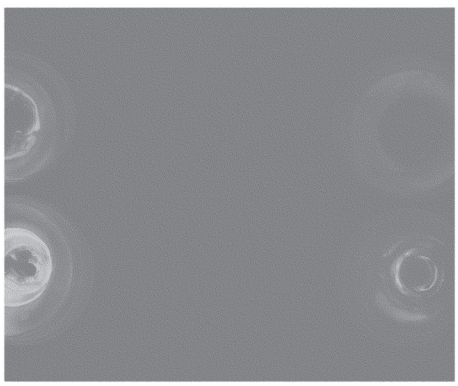
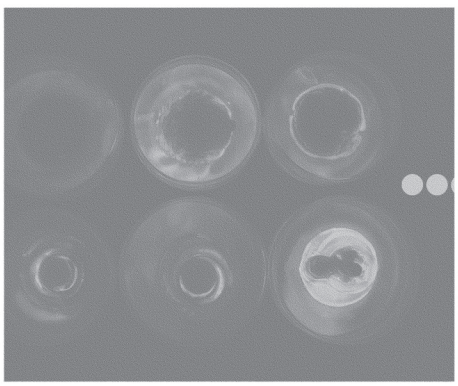
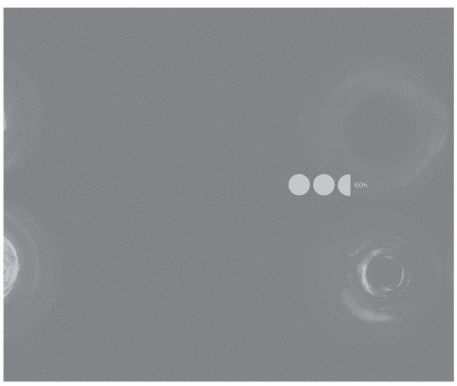
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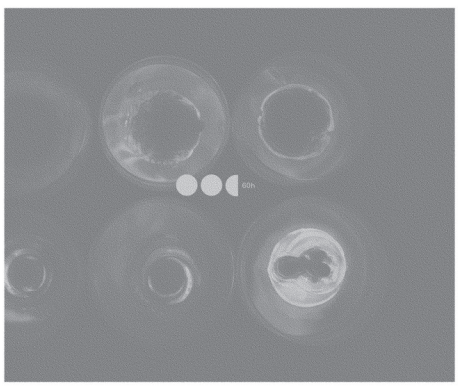
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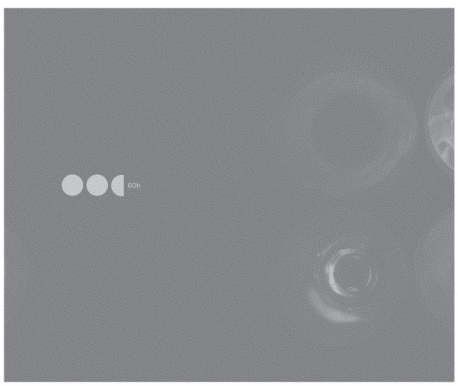
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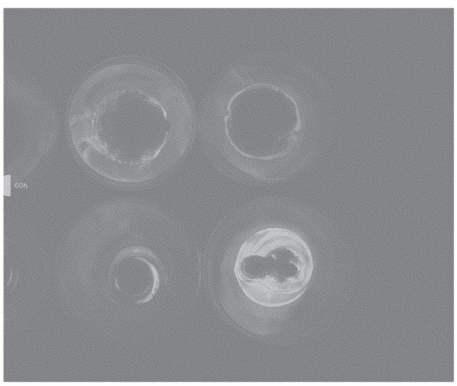
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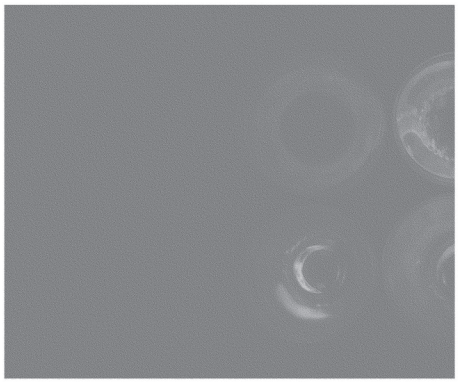
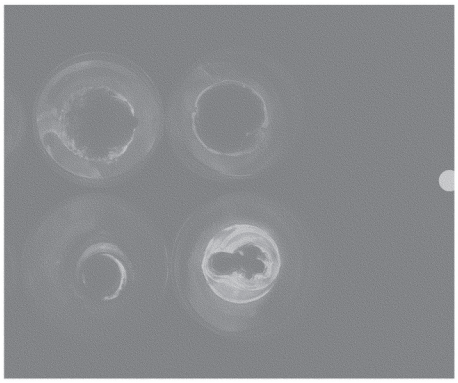
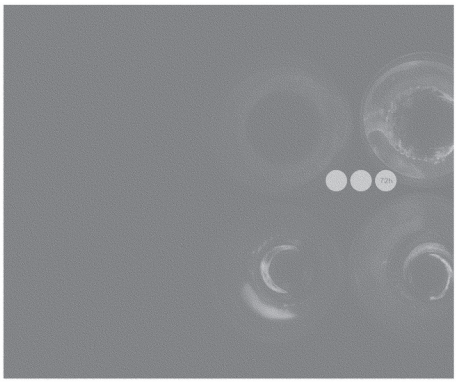
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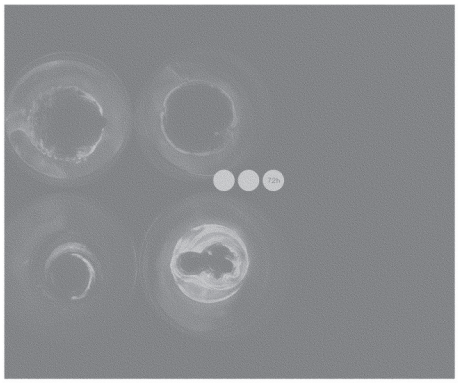
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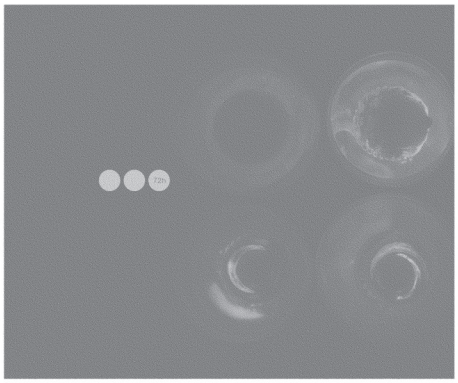
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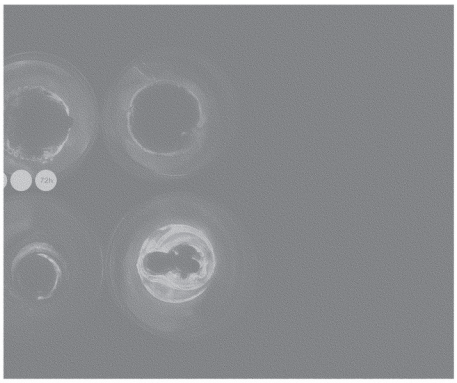
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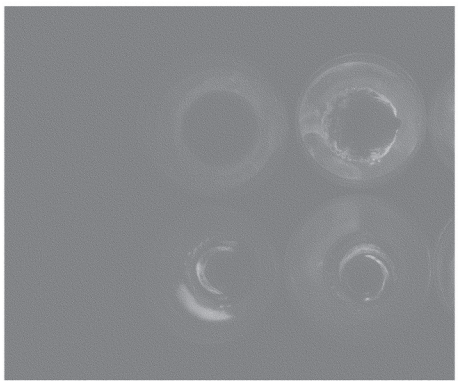
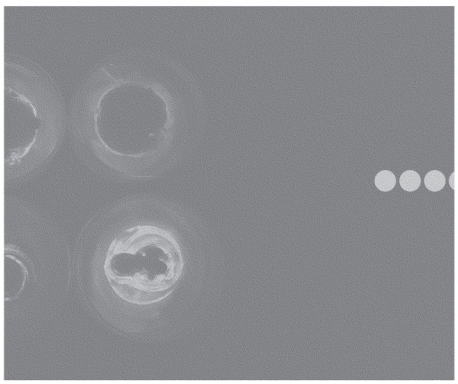
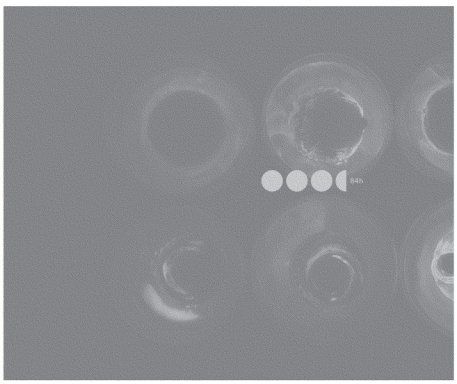
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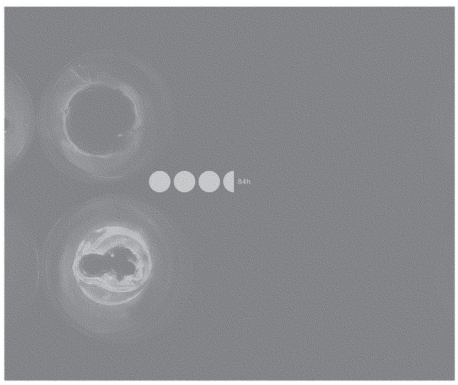
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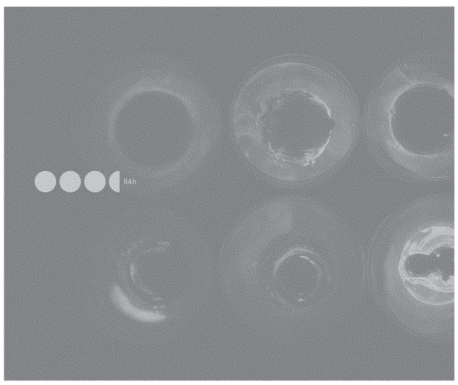
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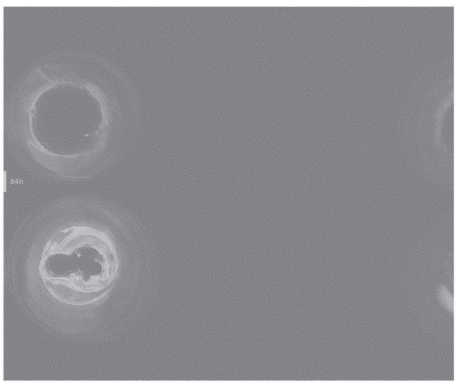
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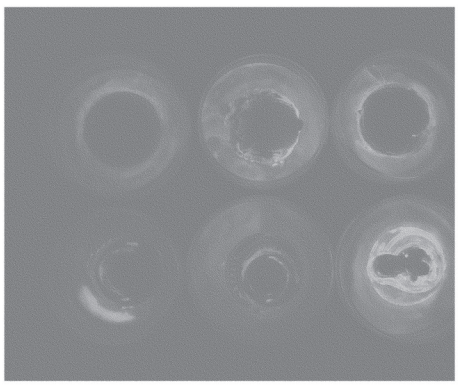
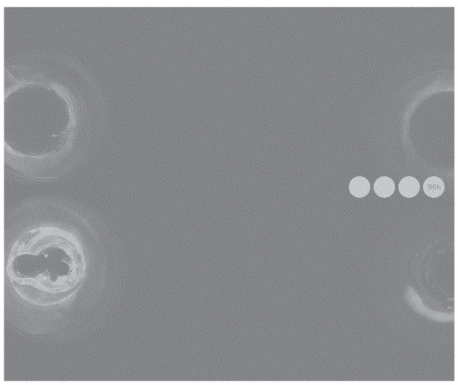
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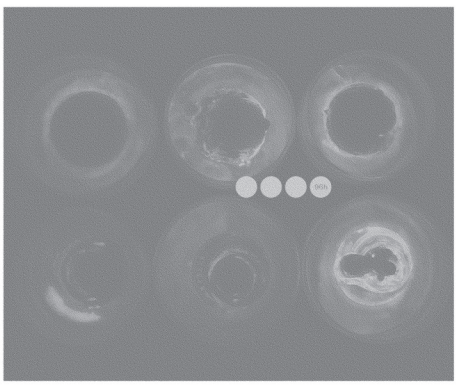
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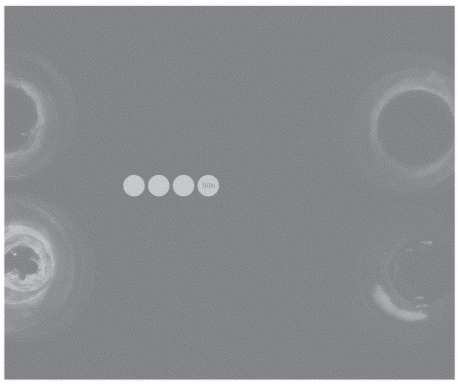
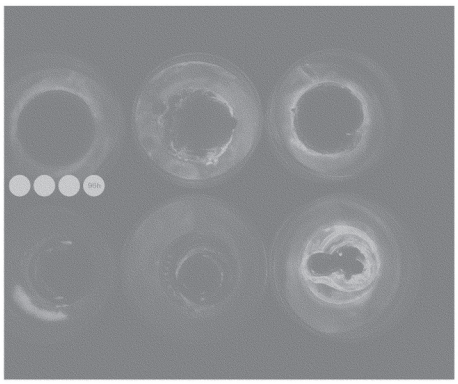
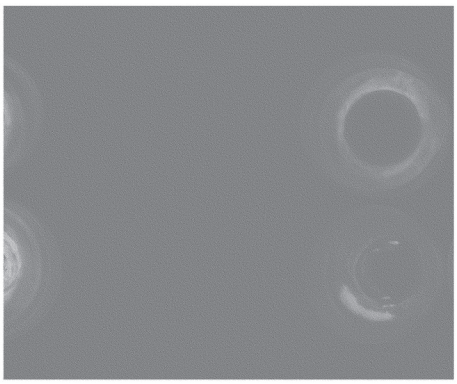
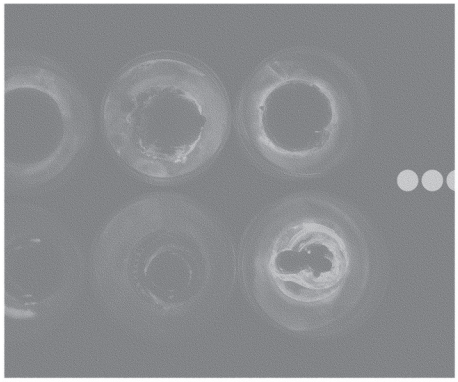
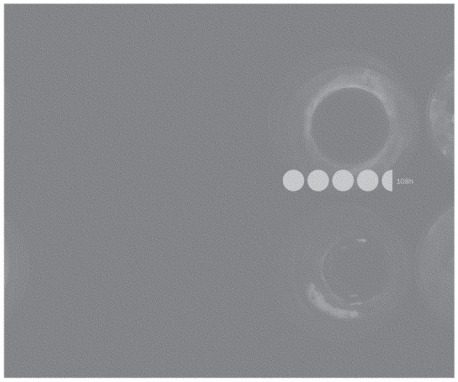
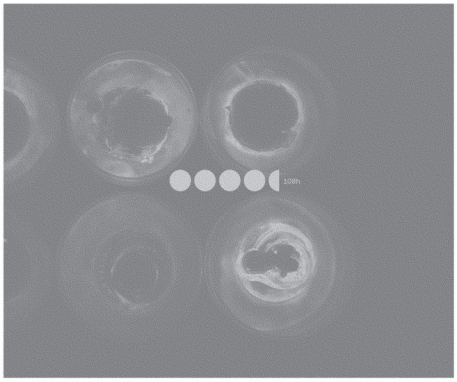
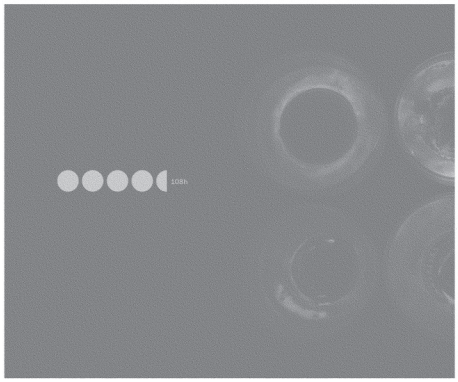
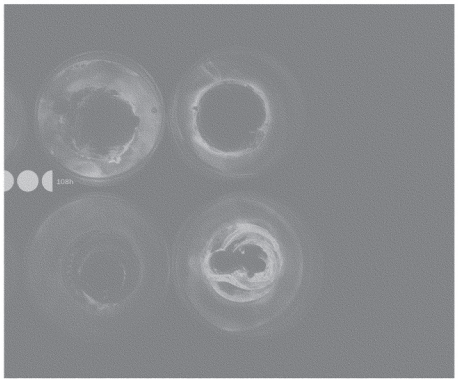
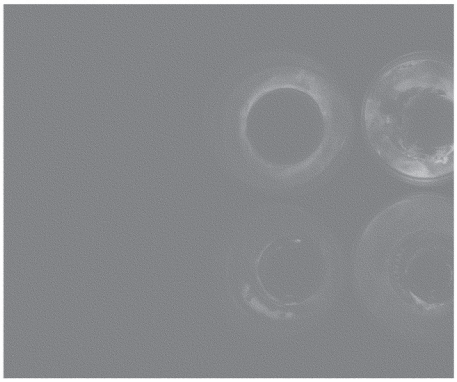
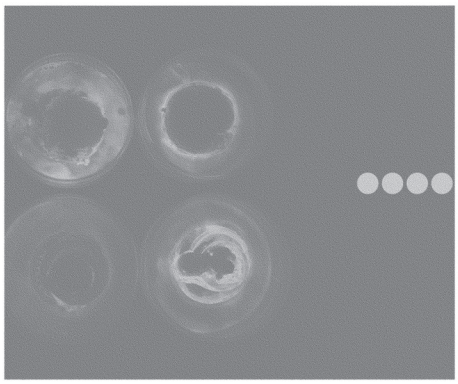
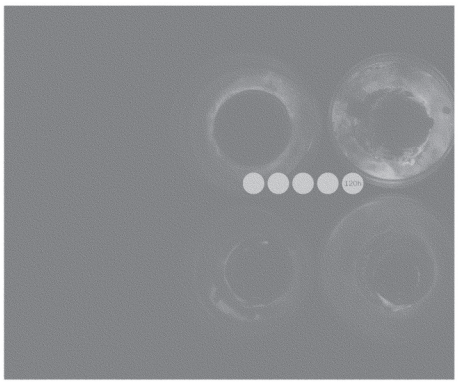
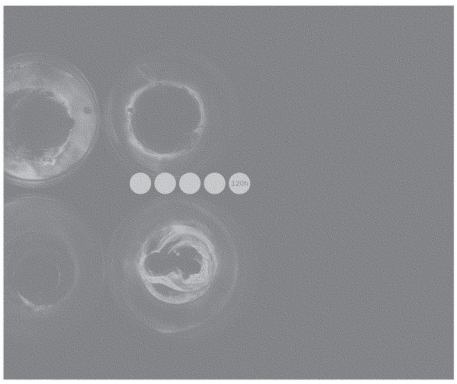
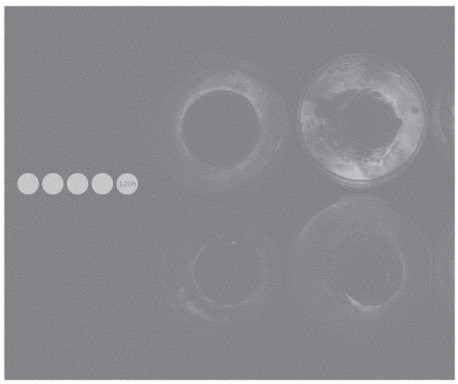
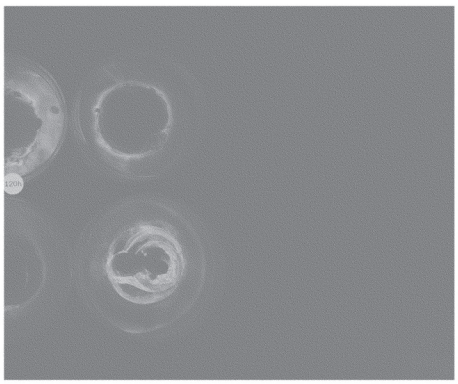
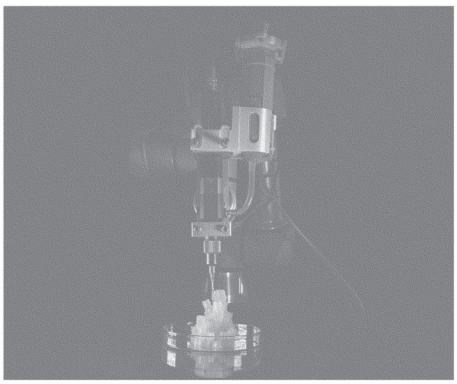

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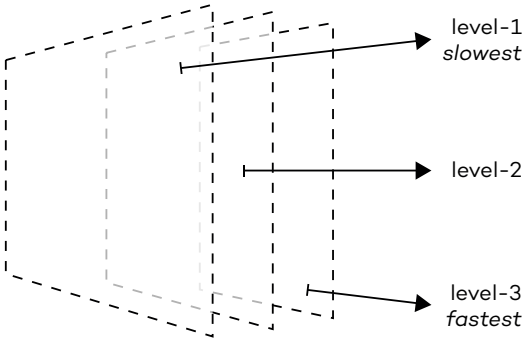

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https://softmatters.ensadlab.fr/
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Mette Ramsgaard Thomsen (PhD) examines the intersections between architecture and new computational design processes, focusing on the profound changes that digital technologies instigate in the way architecture is thought, designed, and built. Founder of CITA (Centre for Information Technology and Architecture) at the Royal Danish Academy, her recent work examines new design principles for bio-design and sustainable design practice.

Martin Tamke is Associate Professor at the Centre for Information Technology and Architecture (CITA) in Copenhagen. He is a design-led researcher in the interface and implications of computational design and its materialization. Projects on new design and fabrication for wood and fiber-based materials led to projects that explore an architectural practice engaged with bespoke materials and behavior.

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Guro Tyse is an architect and researcher working at the intersection of architecture, digital fabrication, and microbiology. She is currently a SACRe PhD student at the École Nationale Supérieure des Arts Décoratifs - PSL Université as part of the project ImpressioVivo funded by the French National Agency for Research (ANR).

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A 3D-printed spiral micro-architecture inhabited by the bioluminescent Vibrio fischeri bacteria, in darkness. *Imprimer la lumière* project, 2021, CITA/Soft Matters. Photo credit: Guro Tyse. Reproduced with permission.

bibliography and references

Chassard, Maëlle. 2015. "Bioentreprise Glowee bio-éclaire les villes de demain." *Biofutur* 367: 64–64.

Van Dongen, Teresa. 2014. *Ambio*. http://www.teresavandongen.com/Ambio

Estévez, Alberto. 2007. "Genetic Barcelona Project: The genetic creation of bioluminescent plants for urban and domestic use." *Leonardo*, no. 4.

Helmreich, Stefan. 2016. "Homo Microbis." In *Sounding the Limits of Life: Essays in the Anthropology of Biology and Beyond*, 62–72. Princeton, NJ: Princeton University.

Mosse, Aurélie. 2021. *ImpressioVivo*. https://softmatters.ensadlab.fr/impressiovivo/

Thomsen, Mette Ramsgaard, Martin Tamke, Aurélie Mosse, and Guro Tyse. 2021, "Designed Substrates for Living Architecture Performance—Imprimer La Lumière." Conference paper, *CEES 2021—Construction, Energy Environment & Sustainability*. Itecons, University of Coimbra, Portugal.

Thomsen, Mette Ramsgaard, Martin Tamke, Aurélie Mosse, Jakob Sieder-Semlitsch, Hanae Bradshaw, Buchwald, Emil Fabritius, and Maria Mosshammer. 2022. "Imprimer la lumière: 3D printing bioluminescence for architectural materiality." In *Proceedings of the 2021 DigitalFUTURES*. CDRF 2021. Singapore: Springer. https://doi.org/10.1007/978-981-16-5983-6_28

Roosegaarde, Daan. 2017. *Glowing Nature*. https://www.studioroosegaarde.net/

Ursell, Luke, Jessica Metcalf, Laura Parfey, and Rob Knight. 2012. "Defining the human microbiome." *Nutrition Reviews* 70, suppl. 1: S38–44. https://doi.org/10.1111/j.1753-4887.2012.00493.x

Yang, Joy. 2012. "The human microbiome project: extending the definition of what constitutes a human." National Human Genome Research Institute. https://www.genome.gov/27549400/the-human-microbiome-project-extending-the-definition-of-what-constitutes-a-human

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MLA	EN	Mossé, Aurélie, Guro Tyse, Martin Tamke, and Mette Ramsgaard Thomsen. "Imprimer la Lumière: Bacterial Luminescence as a 3D-Printed Spiral Micro-Architecture." *.able journal*, 2023. https://able-journal.org/en/imprimer-la-lumiere
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