FACULTY OF BIOSCIENCE ENGINEERING

The Chancellor of Ghent University has the honor of inviting you to attend the public defense of the doctoral dissertation of

ir. Wannes Nauwynck

Title of the doctoral dissertation:

Droplet microfluidics: a toolbox for microbial ecology

The public defense will take place on the 9th of January 2026 at 17:00 in auditorium Oehoe, at the faculty of bioscience engineering, Ghent University (Auditorium E1, building E, Coupure Links 653, 9000 Ghent).

There will be a contiguous reception to which you are heartily invited.
Please confirm your attendance before 11/11/2025 by filling out this form or via mail to wannes.nauwynck@ugent.be.

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GHENT UNIVERSITY

Abstract of the doctoral research

High-throughput functional information is essential to understand microbial communities. Multi-omics techniques are routinely used for this purpose, but they measure the combined signal of many cells at once, making inference of functionality for single-cells more difficult. In contrast, traditional microbiological cultivation-based methods can reveal direct functional information, but they are low in throughput. Increasing resolution and throughput of functionality screening is therefore crucial for better understanding how microbial communities function.
This dissertation investigated the use of droplet microfluidics to address this technological gap. This technique can generate millions of tiny droplets, each acting as an individual microreactor, allowing an entire microbiome to be screened in parallel. We examined its potential both for (i) bacterial isolation, to answer “which species can or cannot grow in droplets?”, for (ii) functional screening, to answer “who does which function?”, and for (iii) interaction screening, to answer “who does what with whom?” in microbial communities.
We found that droplet microfluidics offers evident advantages in throughput and scalability, but that it also introduces specific biases affecting which taxa can be isolated. When throughput advantages were controlled for, conventional cultivation techniques performed comparably to droplet cultivation, with each method showing a unique set of taxa isolated. In functional assays, droplet microfluidics enabled rapid screening of bacterial function, revealing patterns not predicted by taxonomic functional inference. Moreover, we obtained preliminary information on microbial interactions within the studied communities, although further research is needed to refine these data.
In summary, this dissertation demonstrates that droplet microfluidics offers a promising route toward high-throughput, function-based microbiome research, bridging the gap between bulk -omics and actual microbe behavior.

Brief Curriculum Vitae

Wannes Nauwynck (°Gent, Belgium, 23/11/1994) graduated from Ghent University in 2017 as Master of Science in Bioscience Engineering: Cell and Gene Biotechnology. After spending two years working at a research start-up, he obtained a PhD fellowship from the Research Foundation of Flanders to pursue fundamental research on droplet microfluidics and bacterial interactions.
During his doctoral work, Wannes (co-)authored three scientific papers submitted to international peer-reviewed journals and presented his research at several national and international conferences, including FEMS 2023 and CYTO 2024. He also guided two bachelor students, Cas Samoy and Janne Declercq, in completing their thesis projects. Alongside his research, Wannes contributed to teaching the practical sessions of the course Environmental Microbiology and was an organizing member of the Ecology cluster at CMET, where he helped moderate discussions on the latest advances in microbial ecology.