

Understanding and Using Biofilm Microenvironments: Multidisciplinary Goals, Gaps, Required Support, and Critical Skills Inventories

POSITION STATEMENT

Hosted by the Environmental Biotechnology Network and facilitated by Newcastle University

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POSITION STATEMENT FROM WORKSHOP MEMBERS

Developing Microenvironment Capability: Calls to Action for Practitioners and Institutes

Why Microenvironments Matter

Microenvironments, localized zones within biofilms and other microbial environments that differ sharply from their surrounding environment (see definition in 4A ‘Defining “The microenvironment”’), govern microbial behaviour and, by extension, the performance of microbially based biotechnologies. Mastering their control is key to improving process reliability, efficiency, and unlocking new biotechnological applications.

The Promise

The potential impact is transformative. Improved microenvironment sensing, insight, and control can accelerate innovation in waste treatment, resource recovery, and bioprocess optimization, while enabling new technologies that improve sustainability and resilience. Beyond technical advances, fostering collaboration and skill-sharing will create a research culture that is agile, inclusive, and capable of tackling complex challenges at the interface of biology and engineering.

The Challenge

While emerging technologies for measurement and direct control offer exciting possibilities for achieving those goals, progress will depend equally on the ability of practitioners to acquire and share capabilities. This means not only developing internal skillsets but also forging collaborations across disciplines. Practitioners themselves have a critical role to play by embracing accessible language, actively seeking collaborators beyond their immediate domain, and investing time in skill transfer initiatives by developing as well as participating in workshops and shared resources.

Institutes, whether funding bodies or academic, also have a responsibility to: address administrative burdens that consume time and energy, fund structures that favour skill-building over grand initiatives, reconcile existing practices in grant evaluation with acknowledged cross-disciplinary priorities, replace passive networking with active matchmaking, and engender confidence for engaging with industry and outreach.

Our Current Capabilities

A skills inventory conducted during the workshop revealed deep specialization across varied disciplines among practitioners alongside strong interest in growth and collaboration. However, gaps remain in recognizing complementary expertise and in communicating across disciplines. Addressing these gaps requires cultural as well as structural change.

The Way Forward

The path forward is clear: we must invest in people as much as in technology, create structures that actively facilitate collaboration, provide practical guidance to pursuing broader industrial and outreach goals, and reform funding to address mismatches between recognized needs for interdisciplinary work and execution. By doing so, we can accelerate innovation, broaden impact, and ensure that microenvironment research delivers on its promise.