opnMe by Boehringer Ingelheim

Scaling Sustainable Flow Biocatalysis

How would you propose developing scalable and sustainable flow biocatalysis processes for the synthesis of pharmaceutical small-molecule intermediates?

Answers to this question including a proposal for collaboration can only be considered if they arrive no later than September 15, 11:59 pm PST.

Boehringer Ingelheim

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What is the context of the problem that we would like to solve?

Biocatalysis has emerged as a key enabling technology for the preparation of pharmaceutical intermediates, offering high selectivity, shorter synthetic routes, reduced waste, and more sustainable manufacturing. Combining enzymatic catalysis with continuous flow technology offers further potential to improve productivity, enzyme handling, and simplify process work-up compared with conventional batch bioprocessing. There is emerging evidence that continuous flow biocatalysis also holds the promise for lower-waste, more efficient and scalable production of defined intermediates for small-molecule drug discovery and development.

In practical terms, this means carrying out an enzyme-catalyzed reaction in a continuously operating reactor rather than in a stirred batch vessel. The enzyme may be immobilized on a solid support, retained in a membrane reactor, or otherwise confined within the system, while substrate solution is pumped through under controlled conditions. As the reaction stream passes through the biocatalytic zone, product is formed continuously, allowing tighter control of residence time, temperature, mixing, and downstream processing.

Despite this potential, broader implementation of flow biocatalysis remains limited by technical and practical challenges. These may include enzyme stability and reusability, immobilization strategies, reactor design, clogging or pressure build-up, cofactor regeneration, mass-transfer limitations, poorly soluble substrates, product inhibition, and the need to demonstrate clear sustainability benefits over established batch processes.

We are interested in approaches that address one or more of these barriers and enable broader adoption of flow biocatalysis for pharmaceutical small-molecule intermediate synthesis. Solutions may address specific enzyme classes, reaction types, reactor concepts, immobilization approaches, process intensification strategies, analytical methods, or sustainability assessment frameworks that support the development and manufacture of more sustainable medicines.

We welcome proposals that provide a clear scientific rationale, a feasible experimental plan, and a convincing explanation of how the proposed approach could reduce scale-up risk and improve environmental performance. Approaches that are generalizable across relevant biocatalytic transformations, while remaining testable within a 12-month collaboration, would be of particular interest.

In particular, we are interested in developing solutions that demonstrate a credible pathway toward industrial implementation while addressing key challenges in flow biocatalysis, including enzyme stability, reactor operability, process performance, and sustainability for pharmaceutical manufacturing.

What potential solutions could be in scope?

Potential solutions could include approaches that enable more robust, scalable, and sustainable flow biocatalysis for pharmaceutical synthesis in the context of small molecule intermediates.

Examples may include, but are not limited to:

- Strategies to improve enzyme stability and reusability (e.g., transaminases, dehydrogenases, imine reductases, and ketoreductases) for robust and scalable flow biocatalytic reactions.
- Novel immobilization concepts and reactor designs that support reliable long-term operation, including approaches to minimize clogging, pressure build-up, and enzyme deactivation.
- Methods to enhance reaction performance under flow conditions, including improved mass transfer, cofactor regeneration, mitigation of product inhibition, and handling of poorly soluble substrates.
- Solutions for challenging substrates, reaction media, or process integration under continuous operation.
- Sustainability assessments and metrics, including green solvent selection, waste reduction, life-cycle assessment (LCA), process mass intensity, and comparisons between flow and batch biocatalysis to better understand potential environmental benefits and trade-offs.

Proposals should explain how the approach could be implemented experimentally and how success would be measured.

What potential solutions would be out of scope?

Proposals focused solely on discovery or engineering of new enzyme sequences would be out of scope, unless this is clearly required to enable the proposed flow biocatalysis concept or immobilization strategy.

Batch-only biocatalytic processes would be out of scope, except if used as reference processes for comparison with the proposed flow-based approach.

Proposals primarily focused on biologics, peptides, nucleic acid-based therapeutics, or other modalities outside pharmaceutical small-molecule synthesis would be out of scope.

What benefits do we offer to you in exchange for having submitted a solution?

If your project is selected, you will have the opportunity to directly collaborate with the Department of Drug Substance New Chemical Entity (Connecticut, USA) of Boehringer Ingelheim.

You can expect appropriate funding for the intended 12-month collaboration period. Your exact funding request should be outlined in your proposal. As a framework, we suggest that your initial funding request is structured by milestones and does not exceed USD 95,000.

Our collaboration agreement will provide full transparency about each partner's rights & obligations (including intellectual property rights).

A final comprehensive report is due one month after the end of the grant period. As part of the agreement, you will be asked to publish your results in a peer-reviewed technical journal within 6 months after the successful conclusion of the work. Each publication prepared in connection with this Grant shall make acknowledgement in the following manner: "This manuscript was funded by Boehringer Ingelheim's Sustainable Medicines Grant program, whose intent is to enable sustainable medicines for patients. "

What are the key success criteria on which we base our selection for the best answer?

We are seeking well-structured research collaboration proposals that outline:

- A scientifically compelling approach that addresses a relevant challenge in flow biocatalysis for pharmaceutical small-molecule intermediate synthesis.
- A concise explanation of technical feasibility, including any existing data, publications, established assays, or prior experience supporting the proposed concept. Proposals that have generated preliminary data and/or proof-of-concept results will be prioritized.
- Your exact funding request should be outlined in your proposal based on a well-thought-through project. The project should be structured in milestones and planned with key decision points, including clear Go/No-Go criteria. The funding request should not exceed USD 95,000.
- We will only consider project proposals that can be completed within 12 months or less. Within this period, you should be able to generate evidence supporting your hypothesis based on predefined experimental milestones, as well as publishable results.
- Proven track record in the required field of expertise.
- Ability to implement the outlined solution as part of a scientific collaboration project with Boehringer Ingelheim including access to a laboratory.

What information should be included in your answer submission?

Please use our answer submission template to provide a 2–3 page non-confidential proposal (available for download on the following site).

If confidential data exists that would strengthen the proposal, please indicate that information is available to share under a Confidential Disclosure Agreement (CDA). If we find the non-confidential concept proposal sufficiently interesting, we will execute a CDA for confidential discussions.

Anticipated Project Phases or Project Plan

Phase 1	Please complete your submission by **September 15, 11:59 pm PST at** the very latest.
Phase 2	Our review of all proposals will be completed by the end of October 2026 and scientists will be informed after that.
Phase 3	Start of discussions for the collaboration agreement in Q1/2027.

Submitting a collaboration proposal

- Check the outline of the opn2EXPERTS "Scaling sustainable flow biocatalysis" challenge on opnMe.
- Alternatively, you may click the "Get Submission Template" banner to access the submission template.
- Follow the instructions to upload your submission document (requires login or registration).
- The upload allows you to attach additional application files if desired.
- You will be able to access your final submitted collaboration proposal in your personal dashboard and follow its review status.
- Please also visit the FAQ section on opnMe.com to learn more about our opn2EXPERTS More Green program.