



2020 ACS GCI Pharmaceutical Roundtable Research Grant Proposal for the Development of New Membrane Technologies

The ACS Green Chemistry Institute Pharmaceutical Roundtable (GCIPR) is a partnership between the ACS Green Chemistry Institute® and pharmaceutical-related corporations united by a shared commitment to integrate the principles of green chemistry and engineering into the business of drug discovery and production. Current members are AbbVie, Amgen, AstraZeneca, Bayer, Biogen, Boehringer-Ingelheim, Bristol-Myers Squibb, Eli Lilly and Company, F. Hoffmann-La Roche Ltd., Gilead, GlaxoSmithKline, Ipsen, Johnson & Johnson, Merck & Co., Neurocrine, Novartis, Novo Nordisk, Pfizer, Sanofi, Takeda, UCB Pharma, Vertex, and the ACS Green Chemistry Institute. Associate members are Ampac Fine Chemicals, Asymchem, Bachem, CatSci, Codexis, Hikal, Hovione, Innosyn, Pharmaron, Polypeptide, and WuXi AppTec. Chiral Technologies, Corteva Agriscience and EnzyTag are affiliate members.

The ACS GCI Pharmaceutical Roundtable is seeking a one-year R&D commitment toward the development of reliable/cost-effective membranes that could provide solutions to pharmaceutical manufacturing processes, especially in continuous manufacturing. Proposals are invited from public and private institutions of higher education worldwide. This project is intended for a student within the selected Principal Investigator's research group. One grant is planned to be awarded, and the total award is limited to \$50,000 for a grant period of 12 months. Note that this award will be exclusively for R&D. Interested PI's are required to provide a written proposal describing the investigator's capability to carry out the Roundtable's proposed research. The deadline for receipt of proposals is **June 1st, 2020 at 5 p.m. EDT**. Proposals must be received by the deadline to be considered. Submissions must be a single PDF file submitted to gcipr@acs.org. GCIPR will notify the selected PI by **August 15, 2020**. It is expected that research will commence in the Principal Investigator's lab by October 2020 and last approximately 12 months.

Requirements for Submission

Proposals will be accepted from public and private institutions of higher education. The grant is not limited to institutions in the United States. Proposals must be submitted through the appropriate institutional office for external funding. For international submissions, if there is no comparable office, submit a PDF of a letter signed by an appropriate university official recognizing the terms of the grant.

Detailed Project Description

The pharmaceutical industry frequently has to balance process efficiency, robustness and cost with energy efficiency during its manufacturing operations. Membrane systems, particularly in continuous manufacturing mode, could provide a sensible alternative to bring it all together. Membrane technologies have been used for a variety of manufacturing and post-manufacturing operations such as solution concentrations, solvent exchange, solvent dehydration, catalyst recovery and waste water purification, among others. Although great advances have been achieved in recent years, there are still many gaps

related to the use of membranes under certain process conditions, such as temperature, pressure and flow rate, in addition to solvent stability and operability under suspended solids.

To date, membrane technology provides robust process separations of aqueous streams, mostly for waste water treatment and desalinization. Commercial polymeric nanofiltration and reverse osmosis membranes are widely used for these types of applications but their applicability to the pharma industry API operations has been hampered by the lack of these membranes' material robustness and reliability. This has been critical particularly in terms of material resistance to organic solvents and temperatures above 100 °C.

The next-generation of membranes, both polymeric and ceramic-based, will need to provide significant advantages over currently used membrane options. These new types of membranes will need to add material robustness and reliability for processing complex mixtures under extreme conditions.

Corresponding to nanofiltration size requirements and solvent and molecule separation mechanisms, we are seeking new membrane alternatives that could deliver sensitive solutions to the applications described below. A successful alternative will provide separations with greater size selectivity, particularly targeting on solvent and other small molecules with MW ranging from ~50 to ~600 g/mol. The type of membranes needed should also be able to separate solvents from each other, as well as small molecules with small differences in molecular weight.

Project Goal

Development of reliable/cost-effective membranes and membrane systems that could be used for solvent recovery, solvent removal, size-based separation between solutes (200-400 mg/mL) for non-aqueous process intensification and/or purification of products from enzymatic reaction mixtures containing denatured enzymes. In terms of molecules separation, we are looking at molecular weights that vary from ~50 to ~600 g/mol throughout a process including selectivity achieved between two different solutes.

In terms of solvent stability, the membrane needs to work with polar and non-polar solvents like heptane, toluene, 2-MeTHF, THF, IPA, acetonitrile and alcohols, among others. For more examples of desired solvents, the applicants should refer to the [ACS GCIPR Solvent Selection tool](#).

Project Timeline

It is anticipated that one year of research support will be sufficient to provide progress toward intended goals.

Proposal Format (Maximum 3 pages as described below + CVs)

All of the information below—from section A through D—must be submitted as a single PDF file to assure the proposal is reviewed in its entirety.

A) Title Page (*1 page, 12 pt font, 1-inch margins*)

1. Project Title:
2. Principal Investigator:
3. Title / Position(s):

4. Telephone Number(s):
5. Fax Number(s):
6. Postal Mailing Address:
7. Email Address:
8. Research Group Website:

B) Proposed Plan of Work (*2 pages, 12 pt font, 1-inch margins*)

1. Objectives: Briefly state the project objectives
2. Project Approach: Include specific aims and investigations planned
3. Proposed milestone deliveries with brief description of the manner in which the researcher intends to achieve them
4. Brief description of the PI's research facilities and summary of the student's (undergraduate, graduate student and /or postdoc) capabilities to perform the proposed work
5. References (does not count toward your page limit)

Note: The PI should list any existing background intellectual property and/or collaborations they are aware of that might limit the freedom to operate any of the results arising from any research funded by ACS GCIPR. The priority of the Roundtable is to encourage research utilizing reaction conditions that are commercially available with the freedom to use.

C) Detailed Estimated Budget: The total amount requested would include all direct costs, student assistantships, etc. The total award is limited to \$50,000 for a grant period of up to 12 months. This does not count toward your page limit.

1. Institutional overhead costs (indirect costs) should not be more than 10% of the total budget.
2. Post-doctoral associate salary and benefits are supported.
3. Student stipend and benefits are supported. Proposals for support of advanced graduate students are highly favored.
4. PI salary supplements will not be supported.
5. Laboratory supplies and instrument use charges are supported.
6. No funds may be allocated for travel, equipment purchase or repair, or administrative support.

D) Curriculum Vitae of Project Team Members: Please submit a curriculum vitae of each project team member (up to two pages per team member). This does not count toward your page limit.

Report Requirements

- Progress reports or updates are due monthly or bi-monthly from initiation of research and will be discussed in arranged web-conferences. Reports will be shared with the member companies of the Roundtable.
- Reports are to include research milestones/significant outcomes, summary of progress to date noting any deviations from the proposal, and research plans for upcoming months.
- A final comprehensive report is due one month after the end of the grant period. This report must be submitted as a PDF document electronically to gcipr@acs.org. In addition, the content of the report should be targeted for publication in a peer-reviewed technical journal. The paper will

be co-authored by the principal investigator and student(s) performing the work with the guidance of member companies of the ACS GCIPR.

Intellectual Property, Publication Acknowledgement, and Terms of the Grant

- The primary purpose of this grant is the public dissemination of research through publication.
- Every patent, United States or foreign, that results from research funded (in part or in its entirety) by the ACS GCIPR Research Grant shall be immediately dedicated to the public, royalty free.
- Publication of results is expected within 6 months of work completion.
- Each publication prepared in connection with the ACS GCIPR Research Grant shall make acknowledgement in the following manner: “This manuscript was developed with the support of the American Chemical Society Green Chemistry Institute Pharmaceutical Roundtable (www.acsgcipr.org). The ACS GCI is a not-for-profit organization whose mission is to catalyze and enable the implementation of green and sustainable chemistry throughout the global chemistry enterprise. The ACS GCI Pharmaceutical Roundtable, composed of pharmaceutical and related industries, was established in 2005 to encourage innovation while catalyzing the integration of green chemistry and green engineering in the pharmaceutical industry. The activities of the Roundtable reflect its member's shared belief that the pursuit of green chemistry and engineering is imperative for business and environmental sustainability.”
- Acceptance of a Roundtable Grant will be conditional upon agreement by the grantee institution that in the event the Principal Investigator is unable for any reason to conduct the research proposed, the funds, if previously paid by the Roundtable, shall, upon demand, be returned in full to the Roundtable, and further, that in the event the PI is unable for any reason to continue with the research after it has commenced, this grant shall be terminated forthwith and the unexpended and unencumbered balance of any funds theretofore advanced shall be returned to the Roundtable.
- The grantee institution, by acceptance of this grant, provides assurance that support normally provided by the institution for research of the faculty member will not be diminished.
- Applicants may have only one research grant with the ACS GCIPR at a time. In order to close a grant, the ACS GCIPR must receive and approve the required reports.

For additional information:

Website: www.acsgcipr.org

Email: gcipr@acs.org