2022-23

CHEMOURS DISCOVERY RESEARCH AWARD

UNIVERSITY OF DELAWARE
RESEARCH OFFICE

Chemours™

2022-23 UD/CHEMOURS DISCOVERY RESEARCH AWARD GUIDELINES

WEBINAR: 2/16/2023 from 2:00 to 3:00 PM; REGISTER HERE.

DEADLINES: Pre-Proposal: 3/15/2023; Invited Full Proposal: 4/26/2023

The University of Delaware and Chemours Company invite applications for research proposals to be carried out by UD principal investigators on topics of broad interest to Chemours. Projects should have the potential to advance the industries in which Chemours participates or to lead to new Chemours products.

Specific topics for the 2022-23 competition are listed in the Appendix below.

New this cycle: Chemours business unit leads will be available for 1:1 meetings with interested faculty between the kickoff webinar and the proposal due date. Chemours points of contact are:

- **Advanced Performance Materials (APM):** Ben Gould, benjamin.gould@chemours.com
- **Thermal Specialized Solutions (TSS):** Samer Saab, samer.saab@chemorus.com
- **Titanium Technologies (TT):** Mitch Chinn, mitchell.s.chinn@chemours.com

Please note that APM does not have any topic areas open for this competition. Contact information is provided should you have questions about future opportunities with APM.

Eligibility for Chemours Grants

Applicants must be eligible to serve as a principal investigator on a UD-sponsored agreement.

PROPOSAL INFORMATION

Project Budget

Chemours Discovery proposals may request up to $100,000.

Proposal Duration

Chemours Discovery grants are awarded for one year with the period of performance commencing June 1. No-cost extensions may be considered by Chemours when circumstances warrant. Instructions are included the Post-Award section of these Guidelines.

Pre-Proposal Components

Provide a maximum 1,000 word-summary in the application text field of the online application with the following subsections: abstract, scope of work, and discussion of estimated budget. The scope of work should have sufficient detail for reviewers to determine the novelty and feasibility of the research and its relationship to the identified Chemours topic area.

Invited Full Proposal Components & Formatting

Submit Chemours Discovery proposals using the Chemours Discovery Proposal Template. All components should be single-spaced, using 11-pt Arial font with one-inch margins. Additional information such as References, Budget and Budget Justification, PI and co-PI NSF-style Biosketches, and PI and co-PI NSF style Current & Pending Support documents should be combined with the proposal template and submitted as one PDF document. Incomplete applications will be returned without review.

Proposal Summary and Impact Statement (1 page)

- Describe the proposed research with minimal jargon and explain how the research outputs would advance the field, and impact Chemours and/or the scientific community at large.
- How will this research help the PIs to secure additional funding (whether with Chemours or externally) beyond the 1-year scope of the Discovery research project?
- How will the proposed research leverage and augment existing resources and knowledge? Highlight any unique capabilities.
- Describe planned interactions with Chemours during the 1-year term and beyond.

Statement of Work (3 pages)

- Provide a brief gap analysis of the field and clearly identify the problem(s) to be solved with the proposed research.
- Describe how the proposed effort explores an innovative and potentially transformational area of science and technology.
- Outline the research plan with key decision points, milestones, and deliverables. Provide milestones and deliverables in a Gant chart.
- Provide alternative solution strategies as applicable.
- Describe benchmark and reference materials to be used in the study as appropriate.

Response to Specific Questions (~ 1 Page)

- Address the questions raised from the pre-proposal evaluation, if any. This may simply highlight the areas in the full proposal where these questions have been addressed or proved a separate answer.

PROCEDURES FOR SUBMITTING PROPOSALS

1. Pre-proposal summaries must be submitted by the deadline noted above using the online application. Pre-proposals include the full name(s), department, and email addresses of each PI; a working title; the Chemours business unit, topic, and subtopic of the proposal; and the summary of the proposed work.
2. Pre-proposals will be reviewed by Chemours' business unit leads.
3. Select applicants will be invited to submit full proposals by the deadline noted above using round two of the online application. Full proposals need to be entered into PeopleSoft by the PI's department administrator for tracking and approval purposes.

PATENTS AND LICENSING

In the event that the University considers inventions to warrant patent protection, the University may procure and maintain at its own expense patents in the U.S. and foreign countries on inventions made solely by University personnel or jointly with Chemours personnel, which arise from research carried out under this Agreement. University will own the patents relating to any such invention for which it procures patent protection. For jointly-made inventions, Chemours and Chemours personnel will assign all rights to such invention to the University. The university will provide copies of all patent applications to Chemours promptly after filing.

If the University does not procure patents for inventions made solely by University personnel or jointly with Chemours personnel, which arise from research carried out under this Agreement, Chemours may procure and maintain patents at its own expense in the U.S. and foreign countries for such inventions and Chemours will own such patents, i.e., either The Chemours Company FC, LLC or The Chemours Company TT, LLC as determined by

Chemours. Chemours grants to the University a nonexclusive, noncommercial, nontransferable, royalty-free license for teaching and research efforts under patents obtained by Chemours under this agreement.

POST AWARD

Award Selection

Chemours Discovery grants are awarded based on eligibility and merit and administered by the UD Research Office. Evaluations of merit and award selections are made solely by Chemours.

Post Award Administration

Upon notice of award, the UD PI and Chemours business lead will work together to create a Task Order. Awarded proposals will be assigned an award number and purpose code for expenditures once the assigned UD contract and grants (C&G) specialist has received the signed Notice of Award and Task Order. All proposals funded at a level different than proposed, must provide a revised budget before the purpose code is established.

Rebudgeting, Cost Extensions & No-Cost Extensions

Requests for rebudgeting, cost extensions, and no-cost extensions should be directed to the assigned UD C&G and include the award number and purpose code(s). Requests will be sent by the C&G to Chemours.

APPENDIX
2022-23 REQUESTED TOPIC AREAS

Titanium Technologies

1. **SUSTAINABLE SOLUTIONS**

a. **Recycling of TiO2-containing materials**. Chemours Titanium Technologies (TT) is interested in supporting research that would fundamentally advance the ability to recycle polymer composites and complex paint matrices containing titanium dioxide in a practical manner. Topics include advances in strategies related to the detection of different composite compositions for advanced sorting technologies, advances in particle and chemical separation science as well as particle reclamation technologies.[i] Research that integrates science and policy to move towards the preferred use of socially-responsible, recycle-friendly composites and paint technologies is also of interest.

b. **Thermal Reflectivity**. TiO2 is an excellent scatterer of both visible and Infrared (IR) radiation and so has an opportunity to decrease the energy load of cooling buildings in summer months. In certain situations, consumers prefer dark colors, rather than the lighter colors traditionally used for cool buildings. Here visible reflectivity is not desired while high IR reflectivity is. Chemours TT interests in this area are (a) how to modify TiO2 to increase IR reflectance while decreasing visible reflectance and (b) how to quantify, in the field, the cooling effect of such a pigment. Chemours is seeking interest in both material and test development in this area.

c. **Advanced Remediation Technologies**. Chemours TT is interested in supporting research efforts that could lead to breakthroughs in remediation technologies for difficult-to-destroy compounds. New technologies for the destruction of persistent organic pollutants (e.g., PCBs) that are potentially scalable and offer practical advantages over existing methods (e.g., energy savings, sustainability, and pragmatic considerations) are desired.

d. **Chloride-to-Chlorine Recycling.** As part of the chloride process for making TiO2 from ilmenite ores, large quantities of chlorine gas are transported and consumed. A significant portion of chlorine is sequestered as ferrous chloride. Regenerating chlorine gas from a ferrous / ferric chloride source using scalable process(es) represents a sustainable solution having potential economic, safety, and energy-saving benefits.

2. ADVANCED MATERIALS

a. **Catalysts.** Chemours TT is interested in research that advances the basic science related to the identification and selection of titanium oxide materials for catalyst applications. This also includes applications where titanium oxide is used as a support for atomically precise catalyst applications.

b. **Energy.** Chemours TT is interested in advancing the basic science related to the use of titanium oxides, doped titanium oxides, reduced titanium oxides, or byproducts of the TiO2 manufacturing process in clean energy and energy storage applications. Applications include but are not limited to solar hydrogen conversion, lithium ion batteries and thermal storage technologies. More specifically, manufacturing schemes with high yields of titanium sub-oxides are of high interest.[ii]

c. **Electronic Materials**. Chemours TT is interested in basic science supporting emerging applications of titanium oxides for next generation solid state electronics. Materials of interest include titanium oxides, doped titanium oxides, titanium oxide composites, and structured titanium oxide materials for a range of applications, including field modulation, spintronics, optoelectronics, processing/fabrication aids.

3. DATA SCIENCE

a. **Advances in Data Mining-aided Solid-state Materials Discovery and Optimization.** Chemours TT is interested in the further development of techniques, tools, and approaches that facilitate data mining-aided materials discovery for applications in the catalyst, energy storage and/or electronic materials areas. Methods and strategies that enable efficient learning from a limited number of training sets for quantitive structure property relationship models are desired.

b. **Innovative uses of data science to support the TT business**. Chemours TT is interested in exploring the use of data science techniques proven in other areas for potential applications in areas of interest for the Titanium Technology business.

4. ADVANCED ANALYTICAL MEASUREMENTS

a. **Surface Heterogeneity in Particle Systems**. Rapid characterization techniques for identifying and quantifying surface chemistry and surface structure distributions for sub-micrometer particles at is an unmet need in industry. Chemours TT is interested in efforts that push the limits and state-of-the-art in surface characterization.

b. **Techniques for characterizing large-scale particle assemblies**. New techniques for characterizing particle assemblies that provide meaningful and quantifiable morphological insights for structures comprising hundreds to millions of particles are desired. Many of Chemours TT processes and products rely on the development of long-range structure; however, few characterization methods are available to efficiently characterize these systems at the length-scales required while maintaining the necessary resolution (often in the nanoscale). Chemours is interested in supporting the development of new tools that have the potential to characterize particle agglomerate structures in dense slurries/pastes/wet cakes and/or in powders. These tools may characterize the particles themselves or the states of continuum between the particles (e.g., fluid structure, pore tortuosity).

5. Novel Synthesis Routes

a. New and innovative synthesis routes for the scalable production of titanium oxide materials or titanium metal are of constant interest to Chemours TT.

Thermal & Specialized Solutions

1. **THERMAL MANAGEMENT FOR EV:**

   The wide adoption of electric vehicles will be largely linked to their capability of providing a driving range comparable to internal combustion engines. Thermal management of the cabin, the batteries and the power electronics is key in increasing the driving range of the electric vehicles.

   Being able to test the complete thermal systems of electric vehicles is a skill that Chemours TSS would want to develop with the right laboratories and academic partners. This allows understanding the impact of each pf the elements in this thermal system on the driving range and the energy efficiency of the car.

2. **CATALYST**

   Catalysis remains a key interest in both basic and applied science. The performance of catalyst in a chemical reaction is often impacted by the process conditions, the formation of by-products, or the presence of trace impurities. There are several areas of interests for novel catalyst development: hydrogenation catalysts that resist sulfur and/or sulfur containing species; catalyst supports that endure conditions like high temperature oxidation, high temperature reduction, hydrogen chloride, and hydrogen fluoride; chromium-free catalysts for halogen-exchange reactions.

3. **Thermal management for residential heat pump:**

   Residential heat pump has attracted much more attention due to its higher efficiency in heat management than traditional HVAC. Several technical refrigerants are being investigated as a working fluid for these heat pumps: HFO blends are known to provide an optimal balance between the required properties for this application, but recently some hydrocarbons (HC) were proposed for this application. Being able to test systems operating with HFO blends and HC side-by-side is important to understand the advantages and the drawbacks of each solution as well as providing improvement suggestions to always increase the energy efficiency of these systems.

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[i] [i] Mikael C.F. Karlsson, Zareen Abbas, Romain Bordes, Yu Cao, Anders Larsson, Phil Taylor, Britt-Marie Steenari, "Characterization of silicon, zirconium and aluminum coated titanium dioxide pigments recovered from paint waste", Dyes and Pigments, Volume 162, 2019, Pages 145-152, ISSN 0143-7208
Influence of TiO2 particles on pyrolysis of polymer and paint matrix, i.e. solids for selective pyrolysis see:
Nwankwor, P.E., Onuigbo, I.O., Chukwuneke, C.E. et al. Synthesis of gasoline range fuels by the catalytic cracking of waste plastics using titanium dioxide and zeolite. Int J Energy Environ Eng 12, 77–86 (2021);
Karlsson, M.C.F., Corr, D., Forsgren, C. et al. Recovery of titanium dioxide and other pigments from waste paint by pyrolysis. J Coat Technol Res 12, 1111–1122 (2015). https://doi.org/10.1007/s11998-015-9707-y

[ii] Ashish Kumar, Najmul H. Barbhuiya, Swatantra P. Singh, "Magnéli phase titanium sub-oxides synthesis, fabrication and its application for environmental remediation: Current status and prospect", Chemosphere, Volume 307, Part 2, 2022, 135878, ISSN 0045-6535. https://doi.org/10.1016/j.chemosphere.2022.135878