

Rec  
9/30/2020

1

## MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See <http://www.mtsu.edu/sga/cleanenergy.shtml> for funding guidelines. Save completed form and email to [cee@mtsu.edu](mailto:cee@mtsu.edu) or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request Dr. Keying Ding	
Department/Office Chemistry	Phone # (Office) 615-898-2475
MTSU Box # 68	Phone # (Cell) 615-956-5990
E-mail Keying.Ding@mtsu.edu	Submittal Date 09/30/2020

2. Project Categories (Select One)	
Select the category that best describes the project.	
<input type="checkbox"/> Energy Conservation/Efficiency	<input type="checkbox"/> Sustainable Design
<input type="checkbox"/> Alternative Fuels	<input checked="" type="checkbox"/> Other Research and Education
<input type="checkbox"/> Renewable Energy	

3. Project Information
<p>a. Please provide a brief descriptive title for the project.</p> <p>b. The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. <b>Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.</b></p> <p>c. List the source of project cost estimates.</p> <p>d. Provide a brief explanation in response to question regarding previous funding.</p>
3a. Project Title: Bring Green Chemistry on Campus (VIII)
3b. Project Cost Estimate: \$2401.60
3c. Source of Estimate: Chemical Vendors
3d. If previous funding from this source was awarded, explain how this request differs?
This project is in a new and different research direction. The proposed

activities supported by MTSU Clean Energy Funds all contribute to green chemistry research and education. I appreciate the generous supports from MTSU Clean Energy Funds for previous aids. Due to the Covid-19, research progress has been slow. But I am happy to report that this year one research paper from the last period of fund has been peer-reviewed and now under minor revision. MTSU Clean Energy Funds was officially acknowledged in the manuscript. I plan to submit an NSF proposal in October.

#### 4. Project Description

(Completed in as much detail as possible.)

- a. The scope of the work to be accomplished is a detailed description of project activities.
- b. The benefit statement describes the advantages of the project as relates to the selected project category.
- c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
- d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
- e. Provide specific information on anticipated student involvement or benefit.
- f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
- g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

##### 4a. Scope: Work to be accomplished

Amides are a family of compounds that have found ubiquitous applications in chemical, pharmaceutical and agricultural industries, such as drugs, bulk chemicals, polymers, etc. Today, around 25% of the available drugs contain the amide bond. In fact, the formation of the amide bond belongs to one of the most fundamental reactions in both petroleum and biology industries. The state-of-the-art methods to access amides employ the reactions of carboxylic acids or their activated derivatives with amines in the presence stoichiometric amounts of activating reagents like HATU, EDC, T3P, etc. The significant drawback of the conventional methods is that the process is not atom-efficient, generating copious of waste. Thus, it is highly appealing to develop alternative green catalytic methods for the amide bond formation.

Homogeneous transition-metal-catalyzed carbon-carbon and carbon-noncarbon bond formations are among the paramount methods for products with added value. Catalysts based on precious transition metals, such as Ru, Rh, and Os, have significantly promoted this field. However, these precious

metals are rare, expensive, toxic, and non-sustainable. Recently, with increasing concerns on sustainability and economy, base metal surrogates like Fe, Co, Mn, Ni, and Cu are becoming more desirable in catalysis. Some base metals such as Fe and Mn impose minimal environmental and toxicological impact.

In this project, we will develop a new family of novel base metal complexes as catalysts for the amide synthesis. Notable, this reaction is also environmentally friendly with hydrogen gas as the only byproduct. During the funding period, we will synthesize some of the ligands and their metal complexes and test the reactivity. Results will be presented in conferences and published in a peer-reviewed journal.

#### 4b. Scope: Benefit Statement

Since 2013, I have initiated a unique "**Bring Green Chemistry on Campus**" program aiming to disseminate green and sustainable science and technology and educate the next generation of researchers within the MTSU community, throughout collaborative research, teaching and outreach. Previous and current activities have included: (1) Several research projects in green catalysis supported by MTSU Clean Energy Fee Program, which involve undergraduate and graduate participants. The students will have the opportunity of being trained and performing research and becoming skilled scientists in the future; (2) Green chemistry invitational seminars by three well-known US scientists, which are supported by MTSU Distinguished Lecture Fund and Golden Goggle Lectureship. Through these seminars, students can learn what is going on in these cutting-edge research areas and broaden their views. **In 2020, I invited a green chemistry scientist for a zoom seminar and talk to our students. (Prof. Tianning Diao at New York University) The Golden Goggle Lectureship was unfortunately postponed this year due to the Covid-19.** (3) Green chemistry demos and presentations in National ACS meetings, Southeastern ACS regional meetings, Discovery Center at Murfree Spring, and university and local fairs such as Expanding Your Horizons (EYH) (participants are K-12 school girls), new Science Building events (participants are from local elementary schools) and Earth Day posters (open to the MTSU community), etc.; (4) Introduction of a "Green Moments" section in General Chemistry courses (I and II). I incorporate civic engagement in teaching by advocacy of green chemistry concepts and principles. In the General Chemistry classes, I address critical sustainability problems such as global warming and ocean acidification, which are closely related to the topics of the lecture. These "Green Moments" use real-world contexts to teach more complicated concepts in General Chemistry; (5) Advocate to replace common plastic wares and cups with renewable and biodegradable PLA based ones at the MTSU

Student Union food court. We drafted a letter to the President of MTSU and hope that the University can pay attention. **The MTSU Chemistry Club has won 2015 and 2016 ACS Green Chemistry Student Chapter Award.** The proposed project will greatly contribute to "Bring Green Chemistry to Campus" program that will ultimately benefit our MTSU community.

<b>4. Project Description (continued)</b>
<p>4c. Location of Project (Building, etc.)</p> <p>Science Building - 3021</p>
<p>4d. Participants and Roles</p> <p>Keying Ding - supervise the project</p> <p>One graduate student - perform the experiment</p> <p>One undergraduate student - perform the experiment</p>
<p>4e. Student participation and/or student benefit</p> <p>Through this project, students will not only learn basic concepts of green and sustainable chemistry but also get hands-on research experiences in this field. We hope that through our proposed "Bring Green Chemistry on Campus" program, more MTSU students will get involved and learn green chemistry. I anticipate students can learn why green chemistry is so important and they will become interested in green chemistry research, which will benefit their future careers in the sustainable energy field.</p>
<p>4f. Future Operating and/or Maintenance Requirements</p> <p>See 4a and 4b.</p>
<p>4g. Additional Comments or Information Pertinent to the Proposed Project</p> <p>Results from this project will be hopefully published on a peer-reviewed journal and serve as preliminary data for a major external funding application.</p>

## 5. Project Performance Information

Provide information if applicable.

- a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
- b. Provide information on estimated annual energy cost savings in monetary terms.
- c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
- d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

N/A

5b. Annual Energy COST Savings (\$)

N/A

5c. Annual Operating or Other Cost Savings. Specify. (\$)

N/A

5d. Matching or Supplementary Funding (Identify and Explain)

See 4g