Rec 10/5/18

(4)

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 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 10/04/2018

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency		Sustainable Design
	Alternative Fuels	X	Other Research and Education
	Renewable Energy		

3. Project Information
a. Please provide a brief descriptive title for the project. **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. **Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.** c. List the source of project cost estimates. d. Provide a brief explanation in response to question regarding previous funding.
3a. Project Title Bring Green Chemistry on Campus (VI)
3b. Project Cost Estimate $ 3,510

3c. Source of Estimate

chemical vendors

3d. If previous funding from this source was awarded, explain how this request differs?

It is a new and different research project. But the projects supported by MTSU Clean Energy Funds all contribute to green chemistry research and education. I thank generous supports from MTSU Clean Energy Funds for previous aids. As PI, I successfully secured two major National Science Foundation (NSF) grants in 2015 and 2016, totally $443,174. Another NSF grant application is currently pending. Now I am happy to report that this year two more research papers have been published at high impact journals. MTSU Clean Energy Funds was officially acknowledged in both articles.

Links to the papers:

https://pubs.acs.org/doi/abs/10.1021/acs.orglett.8b01775

https://pubs.acs.org/doi/abs/10.1021/acs.inorgchem.8b00043

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

Homogeneous transition metal-catalyzed carbon-carbon bond forming reactions are among the paramount organic synthetic methods for products of high value. One such prominent synthetic strategy is "borrowing hydrogen" which has recently attracted enormous interests in academia and fine-chemical industries. In a typical "borrowing hydrogen" route, a substrate is first dehydrogenated with the catalyst "borrowing" two hydrogen atoms. The dehydrogenated intermediate is then attacked by a nucleophile, leading to an unsaturated intermediate. In the final step, the catalyst "returns" the hydrogen atoms to afford the product and the catalyst regenerates. This approach offers great advantages over conventional methods, as a) no hydrogen acceptor or oxidant is required; b) less waste is generated with water and hydrogen as the only possible byproducts; c) high atom efficiency can be achieved; and d) challenging reactants such as alcohols can be directly used. Alcohols are readily available and some alcohols can be obtained from biomass feedstocks. In addition, with the increasing concerns on environmental and economic problems, catalysts based on earth-abundant, inexpensive, and less toxic base transition metals are becoming more desirable. This designed project will contribute to green and sustainable chemistry.

In this research, we will utilize our recently developed strategies to selectively synthesize long-chain ketones and alcohols, which are both important chemicals that have found ubiquitous applications in chemical, pharmaceutical, and agricultural industries, by manipulating the "borrowing hydrogen" process mediated by our newly developed novel cobalt-based catalyst. Preliminary results already show great promise of success of this project. In this proposed work, we will focus on optimizing reaction conditions, examining the substrate scope, and exploring the mechanism, which will serve as important preliminary data for a major external grant application. We will use the funds to purchase the necessary chemicals in this project.

Students will be trained with advanced organic and inorganic synthetic skills, physical analytical methods and responsible conduct of research. This project will also be integrated with educational/outreach activities in order to disseminate the concepts of green and sustainable chemistry.

4b. Scope: Benefit Statement

Since 2013, I have initiated and established 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 have the opportunity to learn what's going on in these cutting-edge research areas and broaden their views. **In 2019, I plan to invite another renowned green chemistry scientist to MTSU for a seminar and talk to our students**; (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 addresses 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.

4. Project Description (continued)

4c. Location of Project (Building, etc.)

Science Building - 3021

4d. Participants and Roles

Keying Ding - supervise the project

Bedraj Pandey (graduate student) - perform the experiment

One undergraduate student - perform the experiment

4e. Student participation and/or student benefit

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. Most significantly, through this project, students can learn how green chemistry is so important and become interested in green chemistry research, which will benefit their future careers in the sustainable energy field.

4f. Future Operating and/or Maintenance Requirements

See 41 and 4b.

4g. Additional Comments or Information Pertinent to the Proposed Project

Results from this project will be hopefully published on a peer-review journal and serve as preliminary data for a major external funding application.

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)

N/A

SIGMA-ALDRICH

Order Preview(This order has not been submitted)

Web Copy

Order Date:2018-10-04 **Purchase Order:** **Payment Term:Prepaid - 1 day net**	**Email order confirmations to:**

Subtotal:3,471.40 USD
Ice/Special Packaging Charges:38.00 USD
Order Total:3,509.40 USD

Line	Product Number	Description	Qty	Your Reference	Your Price	Net Price
000010	157791-250G	PHOSPHORUS TRICHLORIDE, REAGENTPLUS, 99%	1		56.50	56.50
		1 In Stock from MILWAUKEE 10/04/18				
000020	739014-10ML	BIS[(2-DIISOPROPYLPHOSPHINO]ETHYL)AMINE&	1		186.00	186.00
		1 In Stock from MILWAUKEE 10/04/18				
000030	337773-25G	CHLORODIISOPROPYLPHOSPHINE, 96%	2		177.00	354.00
		2 In Stock from MILWAUKEE 10/04/18				
000040	481408-5G	CHLORODICYCLOHEXYLPHOSPHINE, 97%	1		249.50	249.50
		1 In Stock from MILWAUKEE 10/04/18				
000050	362891-5G	DIETHYLPHOSPHORAMIDOUS DICHLORIDE, 97%	1		67.90	67.90
		1 In Stock from MILWAUKEE 10/04/18				
000060	186171-4X100ML	N-BUTYLLITHIUM SOLUTION, 1.6 M IN HEXAN&	2		147.00	294.00
		2 In Stock from MILWAUKEE 10/04/18				
000070	573949-5G	CHLORODIETHYLPHOSPHINE, 90%, TECHNICAL &	1		291.00	291.00
		1 In Stock from MILWAUKEE 10/04/18				
000080	698482-500MG	(2-BROMOPHENYL)DIPHENYLPHOSPHINE, 97%	1		58.30	58.30
		1 In Stock from MILWAUKEE 10/04/18				
000090	317632-1G	(METHYLCYCLOPENTADIENYL)MANGANESE(I) TR&	1		19.50	19.50
		1 In Stock from MILWAUKEE 10/04/18				
000100	708933-1G	1,1'-BIS(DICYCLOHEXYLPHOSPHINO)FERROCEN&	1		136.50	136.50
		1 In Stock from MILWAUKEE 10/04/18				
000110	702013-2G	1,3-BIS(DI-TERT-BUTYLPHOSPHINOMETHYL)BE&	1		178.50	178.50
		1 : Estimated to ship on 01/25/19				
000120	C39601-25G	CHLORODIPHENYLPHOSPHINE, 96%	1		51.20	51.20
		1 In Stock from MILWAUKEE 10/04/18				
000130	481408-5G	CHLORODICYCLOHEXYLPHOSPHINE, 97%	1		249.50	249.50
		1 In Stock from MILWAUKEE 10/04/18				
000140	341347-5G	BIS(DIISOPROPYLAMINO)CHLOROPHOSPHINE, >&	1		70.30	70.30
		1 In Stock from MILWAUKEE 10/04/18				
000150	362565-5G	BIS(DIETHYLAMINO)CHLOROPHOSPHINE, 97%	1		136.50	136.50
		1 : Estimated to ship on 01/09/19				
000160	695815-1G	BIS(4-METHYLPHENYL)CHLOROPHOSPHINE, 96%	1		149.00	149.00
		1 In Stock from MILWAUKEE 10/04/18				
000170	D71984-100G	DICHLOROPHENYLPHOSPHINE, 97%	1		48.80	48.80
		1 In Stock from MILWAUKEE 10/04/18				
000180	698245-1G	CYCLOHEXYLDICHLOROPHOSPHINE, 95%	1		63.90	63.90
		1 In Stock from MILWAUKEE 10/04/18				
000190	381020-10G	TERT-BUTYLDICHLOROPHOSPHINE, 98%	1		100.50	100.50

		1 In Stock from MILWAUKEE 10/04/18				
000200	570710-50G	TOLUENE-D8, ANHYDROUS, 99.6 ATOM % D	1		442.00	442.00
		1 In Stock from MILWAUKEE 10/04/18				
000210	151807-50G	ACETONITRILE-D3, >=99.8 ATOM % D	1		268.00	268.00
		1 : Estimated to ship on 10/04/18				