Rec 9/30/22

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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: Ngee Sing Chong	
Department/Office: Chemistry	Phone # (Office):615-898-5487
MTSU Box #: PO Box 68	Phone # (Cell) :615-556-5509
E-mail: nchong@mtsu.edu	Submittal Date: October 1, 2021

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency		Sustainable Design
X	Alternative Fuels		Other
	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: Reduction of Toxicants Including Carbon Monoxide and Carcinogenic Benzene from Biofuel Combustion Processes
3b. Project Cost Estimate: The requested project funding of $3,665 will be used for the purchase of an infrared detector and related items needed for the comparative analysis of harmful emission from the combustion of gasoline and biofuels. MTSU Chemistry Department will provide matching funds to cover the purchase of lab consumables for this research project,
3c. Source of Estimate: The price information of the requested items has been provided by the vendor via email. A screenshot of the price quote is

shown below. The last three items totaling $3,665 ($2730+$575+$360) is requested for funding this research project.

D

danielle <danielle@irassociates.com>

To: Ngee Chong; **Cc:** Irwin423@cs.com

Infrared Associates Inc., is pleased to offer the following quotation for the following items:

	FTIR-16-0.10 mounted in KR-323, cut out at 16.6um	$ 2,650.00/ea
	FTIR-16-0.25 mounted in KR-323, cut out at 16.6um	$ 2,650.00/ea
	FTIR-16-0.50 mounted in KR-323, cut out at 16.6um	$ 2,730.00/ea
	MCT-1000 Preamplifier	$ 575.00/ea
	Low power supply	$ 360.00/ea

Shipping charges are additional.

Lead time is 4-5 weeks.

Best Regards,

Danielle MacNamara

InfraRed ASSOCIATES INC
Danielle Macnamara
2851 SE Monroe Street
Stuart, FL 34997
Phone: 772-223-6670 ext. 101
Email: Danielle@irassociates.com

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

My last Clean Energy project funding is for the purchase of sample introduction accessory of solid phase microextraction, which is needed for the study of wildfire emissions. This request is for the purchase of infrared detector to be used with a Fourier Transform infrared (FTIR) spectrometer equipped with a long pathlength gas cell capable of detecting carbon monoxide and carcinogenic compounds like benzene and formaldehyde.

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

The growing need for renewable sources of fuel has propelled the research in biofuels including biodiesel. The outcomes of biofuel production is to decrease the world's reliance on fossil fuel and reduce environmental degradation due to the use of petroleum-based fuels. Biodiesel produced from transesterification of seed oils have comparable properties with diesel fuel and yield environmental benefits relative to diesel produced from petroleum. In this study, biodiesel production based on the ultrasonication method was found to have numerous advantages when compared with the traditional heating method for biodiesel production. This process intensification technique makes the reaction to occur at a faster rate with considerably less catalyst used.

The use of homogenous catalyst in biodiesel synthesis leads to generation of wastewater. Hence, there is a need for a heterogenous catalyst that is reusable and precludes the need to wash the biodiesel product and generate wastewater. This project studies the use of heterogenous calcium oxide catalysts derived from waste oyster and mussel shell for the production of biodiesel. These seashells were calcined at 1000 0C for 4 hours to obtain calcium oxide. The solid CaO catalyst produced were characterized by XRF, XRD, TGA, SEM, FTIR and ICP-OES spectroscopy. The catalytic activity of the CaO-based catalyst was demonstrated for the transesterification of canola and vegetable oils with methanol. The oyster-based CaO showed better catalytic efficiency when compared to the CaO obtained from mussel shells.

The crude glycerol by-product from the transesterification reaction of biodiesel was used to synthesize solketal, an oxygenated fuel additive for blending with B20 and B40 biodiesel fuels to reduce pollutants and improve the emission profiles of the fuel blends. Other oxygenated additives such as diglyme, triglyme, triacetin, including solketal was compared to see which oxygenated additives perform best in reducing pollutants. The

increase in oxygen content of the fuel blends results in the reduction of carbon monoxide, ethylene, formaldehyde, benzene, and other toxic compounds in the emission profile. Carbon monoxide is known for binding irreversibly to hemoglobin so that it reduces the oxygen-carrying capacity of blood till the affected person lose consciousness. Other toxicants like formaldehyde and benzene are linked to cancer. Therefore, it is important to carry out the comparative evaluation of different biofuel components in reducing these harmful components.

4b. Scope: Benefit Statement

Biodiesel produced from triglycerides or seed oils from plants have been used as blending components of transportation fuels in the U.S., Europe, and Asia. Besides being an important form of renewable biofuel, biodiesel also offers clean-burning emission profile and better lubricity compared to petroleum diesel. Our research focus on the use of other biofuel components such as triacetin, solketal, and diglyme to further lower the levels of toxicants that are harmful to human health.

4. Project Description (continued)

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

The Analytical Chemistry Research Laboratory (SCI 3070) and the Molecular Spectroscopy Laboratory (Room 3093) in the Science Building will be used for carrying out the experiments on the production of biofuels and the analysis of biofuel emissions using the FTIR instruments, respectively.

4d. Participants and Roles

Project Leader-Dr. Ngee Sing Chong (Planning and implementing the project and directing students in the production of biofuels and analysis of toxicants released from fuel combustion.)

Instrument Support Specialist-Mr. Jessie Weatherly (In charge of the maintenance and repair of instruments throughout the project)

4e. Student participation and/or student benefit

This project provides experiential learning opportunities for students from different departments. In addition to FTIR spectrometry, chemistry majors will also learn useful laboratory techniques such as inductively coupled plasma-optical emission spectrometry (ICP-OES), X-ray fluorescence spectroscopy, and gas chromatography-mass spectrometry (GC-MS). Students participating in Dr. Chong's research projects has a long history of receiving industrial job offers upon graduation.

4f. Future Operating and/or Maintenance Requirements

The project will continue with the support of Chemistry Department at MTSU. The preliminary data obtained after Year 1 will be used to prepare a proposal for external funding by National Science Foundation. The MTSU lab fees for chemistry courses will be used to purchase liquid nitrogen and other supplies required for FTIR analysis.

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

This project seeks to develop efficient methods for the producing biofuel components that would minimize harmful inhalation exposure to toxic compounds. These compounds including carbon monoxide, formaldehyde, and ethylene will be analyzed by infrared spectrometry with a multipath gas cell with an optical pathlength of 10 meters. The infrared detector of the FTIR spectrometer has reduced sensitivity because it has been used for 14 years without replacement. Therefore, this proposal requests the purchase of a new infrared detector in order to achieve low detection limits for these compounds.

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.)

Not Applicable

5b. Annual Energy COST Savings ($)

Not Applicable

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

Not Applicable

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

Dr. Chong receives support from Chemistry Department for the purchase of consumable research supplies. The graduate student working on this research project is supported by graduate stipend for conducting the thesis-based research. The undergraduate students involved in this project receive course credit for the CHEM 3880 course.