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Virginia Polytechnic Institute and State Univ
North End Center, Suite 4200
300 Turner Street, NW
Blacksburg, VA 24061 -0001

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UU	UU	UU	UU		19b. TELEPHONE NUMBER 540-231-9138

RPPR Final Report
as of 24-May-2023

Agency Code: 21XD

Proposal Number: 75735SMRIP **Agreement Number: W911NF-20-1-0198**
INVESTIGATOR(S):

Name: Ayman M Karim
Email: amkarim@vt.edu
Phone Number: 5402319138
Principal: Y

Organization: **Virginia Polytechnic Institute and State University**
Address: North End Center, Suite 4200, Blacksburg, VA 240610001
Country: USA
DUNS Number: 003137015 EIN: 546001805

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Final Report for Period Beginning 15-Jun-2020 and Ending 14-Jun-2022
Title: Acquisition of a Nano-Calorimetric System for Detailed Characterization of Next-Generation CWA Catalysts
Begin Performance Period: 15-Jun-2020 **End Performance Period:** 14-Jun-2022
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Submitted By: Ayman Karim Email: amkarim@vt.edu
Phone: (540) 231-9138

STEM Degrees: **STEM Participants:**

Major Goals: The objective of this DURIP project was to acquire and build a nano-calorimeter system for very sensitive measurements of adsorption and reactions of different molecules on catalytic surfaces.

Accomplishments: • All parts have been acquired and tested individually.
• The calorimeter, gas dosing system, vacuum pump and flow controllers have been assembled and connected to a computer for automation.
• The dosing system and calorimeter are currently being commissioned and benchmarked using known standards.

Training Opportunities: Nothing to Report

Results Dissemination: Nothing to Report

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI
Participant: Ayman Karim
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
National Academy Member: N

Participant Type: Graduate Student (research assistant)
Participant: Raian Yousuf
Person Months Worked: 1.00 **Funding Support:**

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Project Contribution:
National Academy Member: N

Partners

,

I certify that the information in the report is complete and accurate:
Signature: Ayman Karim
Signature Date: 3/10/23 3:30PM

W911NF2010198

Acquisition of a Nano-Calorimetric System for Detailed Characterization of Next-Generation CWA Catalysts

Final Report

PI Ayman M. Karim
Department of Chemical Engineering, Virginia Tech
Blacksburg VA 24061
540-231-9138 amkarim@vt.edu

The objective of this DURIP project was to acquire and build a nano-calorimeter system for very sensitive measurements of adsorption and reactions of different molecules on catalytic surfaces.

Accomplishments:

- All parts have been acquired and tested individually.
- The calorimeter, gas dosing system, vacuum pump and flow controllers have been assembled and connected to a computer for automation.
- The dosing system and calorimeter are currently being commissioned and benchmarked using known standards.

System assembly and integration:

Due to COVID, some parts were backordered and only arrived in late 2021 and summer 2022. Additionally, a power supply that runs the calorimeter broke down and had to be replaced in summer 2022 which caused major delays to the assembly of the system. We have finally been able to finish testing the vacuum pump, the mass flow controllers, calorimeter cell and gas dosing system. We have also assembled all the individual parts (Figure 1) and we are currently testing the vacuum level in the overall system (gas lines, gas dosing system and calorimeter cell) and starting to benchmark the system. The assembled system can be seen in Figure 1. Figure 2 shows a closer look at some parts and connections between them.

Benchmarking and commissioning the calorimeter for research

We are currently using standard catalyst samples with known heats of adsorption of CO and H_2 to benchmark the assembled calorimeter system. Additionally, since this calorimeter has a much high sensitivity and is planned to be used for ultra-low loading samples, we will be testing the low detection limit by diluting the standard catalyst samples. According to our estimates, we should be able to measure catalysts with metal loading as low as 0.001 wt%.

After the benchmarking and testing the detection limit of the system, we will start testing single atom and small cluster catalysts that are currently being investigated in ARO projects W911NF-19-1-0308 and W911NF-20-2-0058.

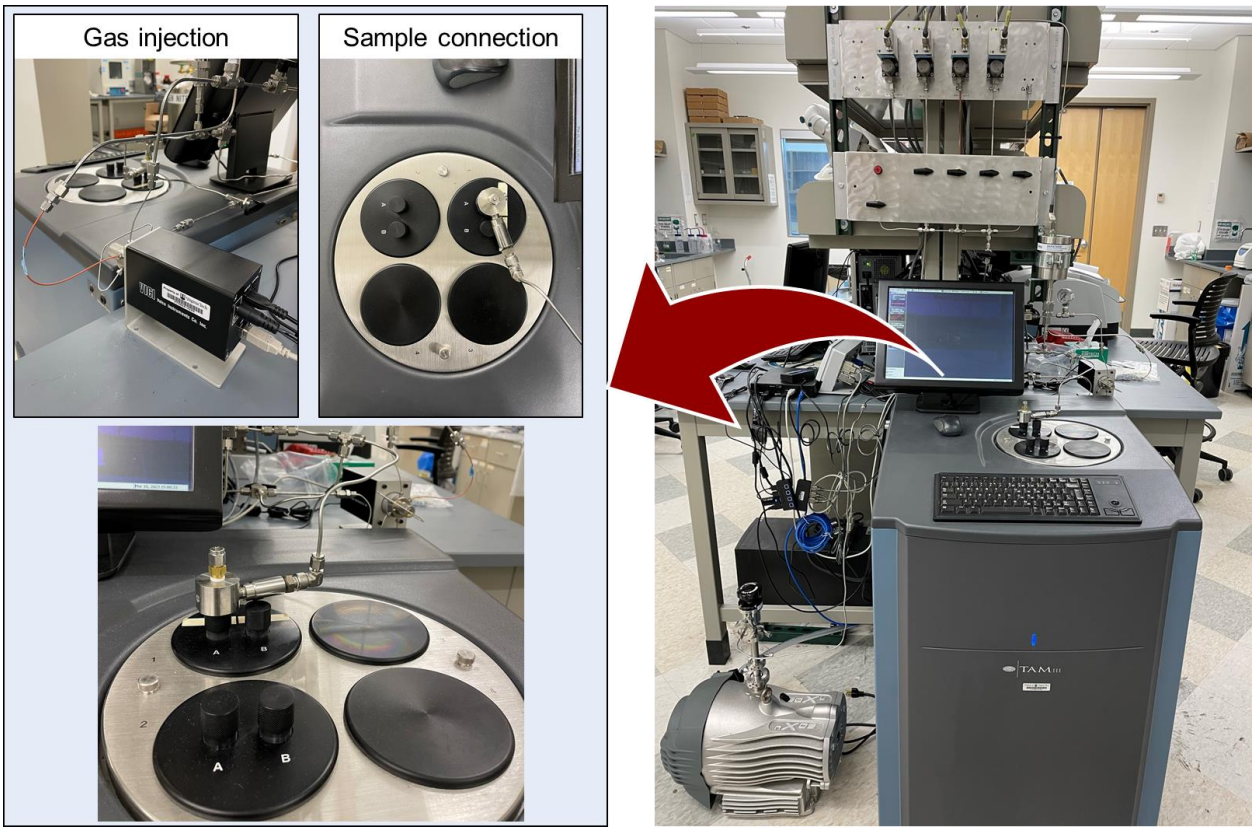

Figure 1: *Assembled system*

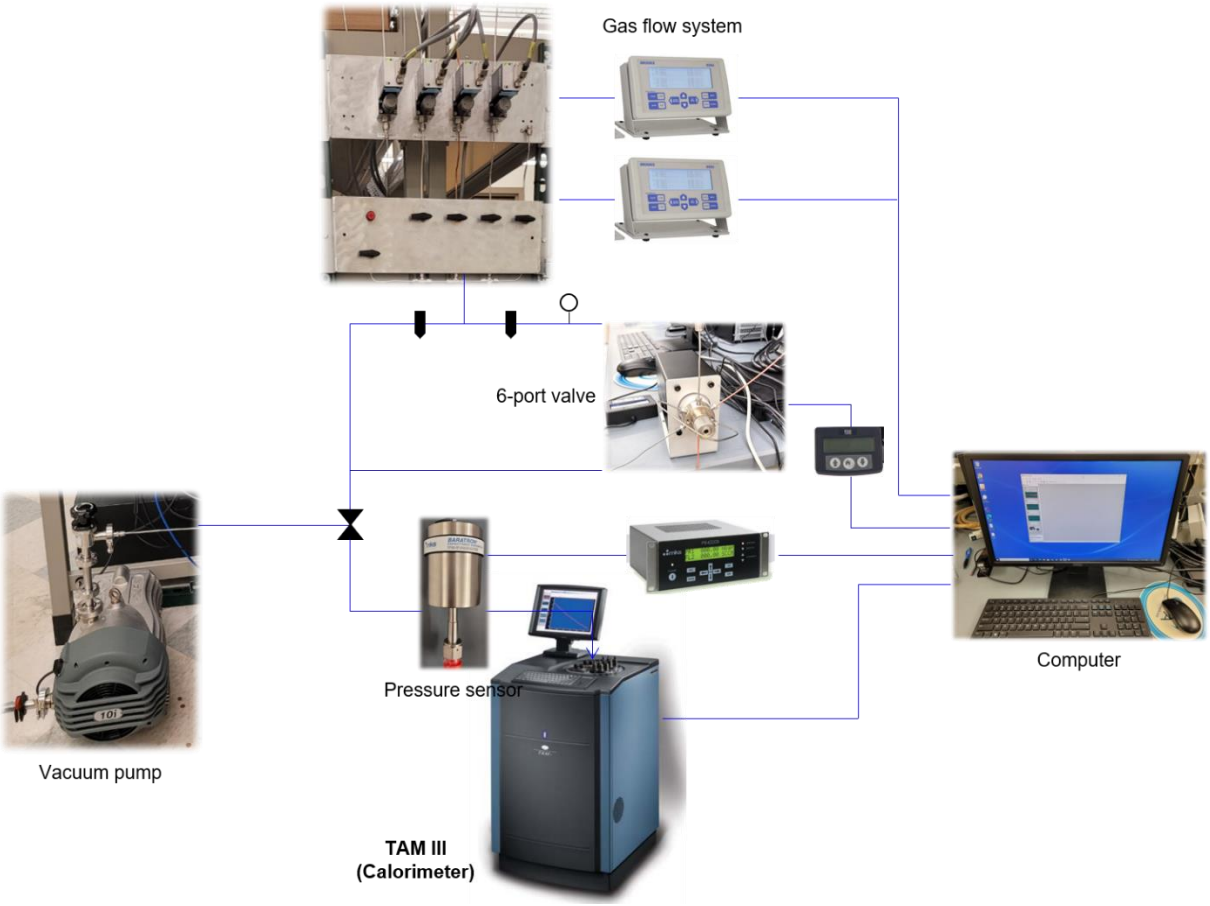

Figure 2: *Different parts of the assembled system shown in Figure 1*