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RPPR Final Report

as of 21-Sep-2023

Agency Code: 21XD

Proposal Number: 78178SMREP

Agreement Number: W911NF-21-1-0213

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DUNS Number: 066023870

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Report Date: 13-Aug-2022

Date Received: 15-Sep-2023

Final Report for Period Beginning 14-May-2021 and Ending 13-May-2022

Title: Powder X-Ray Diffraction Analysis of Nanoparticle-Doped Metal-Organic Frameworks for Water Purification Applications and Enhanced Undergraduate Research

Begin Performance Period: 14-May-2021

End Performance Period: 13-May-2022

Report Term: 0-Other

Submitted By: Cheryl Richardson

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Distribution Statement:

STEM Degrees:

STEM Participants:

Major Goals: To augment current research efforts on the synthesis and characterization of nanoparticle-doped MOFs (NP@MOFs) for water purification applications.

To inspire intellectual curiosity and scholarly activity among undergraduate students by engaging them in relevant and substantive research.

To integrate the use of X-ray diffractometry into the curriculum through current courses and one course that has been recently inactive (CHE 420 Instrumental Analysis)

Accomplishments: To date, the proposed MOFs have been synthesized and PXRD samples have been run, but not with satisfactory results. Some experimentation nanoparticle encapsulation has already commenced, however there is still more to be done for any publishable findings. The final component which is the pH testing is expected to be completed and results submitted for publication by end of the 2023-24 academic year. All proposed funding for equipment (XeriPrep and D2 PHASER) and salary as been spent, which should leave only the \$1,000 allocated for a training on the D2@PHASER which was offered with at no cost with installation. While this progress on the project has encumbered by delays, it has still ultimately been a great benefit the establishment my research program at Virginia Union University and now at Virginia State University. It has also benefited undergraduate students in my inorganic chemistry laboratory course as well as 3 students through independent research over the last year through training in powder x-ray diffraction analysis, which will be invaluable in any materials research they may pursue in the future. Once the work is complete, results should enhance understanding of how to manipulate porous nanomaterials for targeted applications including water purification and biomedical

Training Opportunities: One staff member (laboratory technician) and one student operation of the powder x-ray diffraction (PXRD) at Virginia Union University before I moved to Virginia State University (VSU). At VSU, three (3) undergraduate research students were trained on the instrument as well as six (6) additional students who were enrolled in inorganic chemistry lab, where operation of the instrument and analysis of samples was required.

Results Dissemination: Nothing to Report

Honors and Awards: Fulbright U.S. Scholar

RPPR Final Report
as of 21-Sep-2023

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI

Participant: Karl Jackson

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Partners

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I certify that the information in the report is complete and accurate:

Signature: Karl Jackson

Signature Date: 9/15/23 10:43AM

Powder X-Ray Diffraction Analysis of Nanoparticle-Doped Metal-Organic Frameworks for Water Purification Applications and Enhanced Undergraduate Research

Research and Education Program for Historically Black Colleges and Universities and Minority-Serving Institutions Equipment/Instrumentation FOA: W911NF-20-S-0010

Karl T. Jackson, Sr. Ph.D.
Virginia Union University, Richmond, VA, 23220

Final Technical Report

DoD Agency to evaluate application: Army Research Office

Scientific Division: Material Science

Technical Area: Physical Properties of Materials

The purpose of this project was to acquire a Bruker D2 PHASER desktop diffractometer and a XeriPrep Degasser by Quantachrome for the characterization of metal-organic frameworks (MOFs) and enhancement of undergraduate research and training at Virginia Union University. The goals were to:

1. To augment current research efforts on the synthesis and characterization of nanoparticle-doped MOFs (NP@MOFs) for water purification applications,
2. To inspire intellectual curiosity and scholarly activity among undergraduate students by engaging them in relevant and substantive research, and
3. To integrate the use of X-ray diffractometry into the curriculum through current courses and one course that has been recently inactive (*CHE 420 Instrumental Analysis*).

Specific aims of the proposed research investigations will be (i) to investigate the structural stability of MOFs upon prolonged exposure to water, (ii) to determine the dependence of select MOF stabilities on pH, and (iii) to determine the impact of Nickel(II)-nanoparticles (NiNPs) doping on stability of MOFs in water.

In May of 2022 Virginia Union University received delivery of the Bruker D2 PHASER, which was purchased from Bruker AXS, LLC followed by installation and training. The XeriPrep degasser by Quantachrome was received in September of 2021 from Anton Paar USA, Inc (which is the parent company of Quantachrome). By the time both instruments had been received, I was

moving to a new institution the following month (June 2022). This time between ordering and final delivery unfortunately precluded any significant progress in the proposed project before I left the university, however the project is still ongoing. The transfer process has been long and arduous which has caused even further delay in progress. To date, the proposed MOFs have been synthesized and PXRD samples have been run, but not with satisfactory results. Some experimentation nanoparticle encapsulation has already commenced, however there is still more to be done for any publishable findings. The final component which is the pH testing is expected to be completed and results submitted for publication by end of the 2023-24 academic year. All proposed funding for equipment (XeriPrep and D2 PHASER) and salary as been spent, which should leave only the \$1,000 allocated for a training on the D2@PHASER which was offered with at no cost with installation. While this progress on the project has encumbered by delays, it has still ultimately been a great benefit the establishment my research program at Virginia Union University and now at Virginia State University. It has also benefited undergraduate students in my inorganic chemistry laboratory course as well as 3 students through independent research over the last year. Once the work is complete, results should enhance understanding of how to manipulate porous nanomaterials for targeted applications including water purification and biomedical applications.