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14. ABSTRACT
The acquisition of a small-angle X-ray scattering (SAXS) system for characterizing nanostructured polymers for research and education at Texas A&M University is requested. The targeted model is the S-MAX 3000 High Brilliance 3 Pinhole SAXS System (Rigaku) with a high intensity MicroMax(MM)-003 micro-focus X-ray generation system (sealed micro-focus X-ray tube). The S-MAX 3000 pinhole SAXS camera design includes a high brilliance X-ray source and a 3-meter, fully evacuated camera length, which provides both high intensity and high resolution. Coupled with a fully integrated two-dimensional multi-wire proportional counter, the system is capable

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Report Title

Final Report: Small-angle X-ray Scattering for Nanostructured Polymers Research and Education

ABSTRACT

The acquisition of a small-angle X-ray scattering (SAXS) system for characterizing nanostructured polymers for research and education at Texas A&M University is requested. The targeted model is the S-MAX 3000 High Brilliance 3 Pinhole SAXS System (Rigaku) with a high intensity MicroMax(MM)-003 micro-focus X-ray generation system (sealed micro-focus X-ray tube). The S-MAX 3000 pinhole SAXS camera design includes a high brilliance X-ray source and a 3-meter, fully evacuated camera length, which provides both high intensity and high resolution. Coupled with a fully integrated two-dimensional multi-wire proportional counter, the system is capable of making highly sensitive measurements for both isotropic and anisotropic materials. The Rigaku S-MAX 300 possesses high brilliance, is user friendly, and requires significantly low maintenance costs to maintain high levels of operation over a long lifetime. The SAXS system measures phase-segregated structural features of polymers in the dimensions of nanometers, which is critical in understanding structure-property relationships in functional polymers. The PI is actively involved in highly collaborative DoD-funded research in polymeric materials with ARL scientists. The requested SAXS system will have a significant impact on advancing this research with a detailed understanding of morphology and properties at the nanometer scale. The proposed instrument will also have a strong educational impact, which will build on existing strengths of Texas A&M in graduate, post-graduate, and undergraduate research, as well as interaction with students and teachers at the K-12 level.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

TOTAL:

Number of Manuscripts:

Books

Received Book

TOTAL:

Received	Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

Graduate Students

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Post Doctorates

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Faculty Supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: 0.00

Names of Personnel receiving masters degrees

NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED

FTE Equivalent:

Total Number:

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

This grant enabled the acquisition of a small-angle X-ray scattering (SAXS) system for characterizing nanostructured polymers for research and education at Texas A&M University. The Rigaku S-MAX 300 S-MAX 3000 High Brilliance 3 Pinhole SAXS System with a high intensity MicroMax(MM)-003 micro-focus X-ray generation system (sealed micro-focus X-ray tube) was purchased. The SAXS system is having significant impact on advancing research and education with a detailed understanding of morphology and properties at the nanometer scale.

Technology Transfer

FINAL PROGRESS REPORT

Title: Small-Angle X-ray Scattering for Nanostructured Polymers Research and Education

PI: Yossef A. Elabd
Institution: Texas A&M University

Statement of Problem

Prior to this grant, a small-angle X-ray scattering (SAXS) system was not available at Texas A&M University. This was surprising since Texas A&M is one of the largest universities in U.S. in both enrollment and physical size. Texas A&M is also one of only 62 institutions to hold membership in the prestigious Association of American Universities (AAU) due to its recognition in scholarship, annual research expenditures (~$820M), and endowment (~$8.7B). SAXS is a critical tool for measuring the phase-segregated structural features in polymers in the dimensions of nanometers via elastic scattering of X-rays at very low angles. The experimental data from SAXS is critical in understanding structure-property relationships in functional polymers and this equipment was in high demand at Texas A&M University due to the high concentration of faculty engaged in polymers research.

Summary of Results

The proposed SAXS system was purchased from Rigaku at a purchase price of $390,000. The SAXS system was installed at Texas A&M University in the Jack E. Brown Building and established as a shared-resource facility, which has been readily available to all faculty/students at Texas A&M University and other surrounding universities and industry. The SAXS system purchased from Rigaku is the dual chamber S-MAX 3000 High Brilliance 3 Pinhole SAXS System with a high intensity MicroMax-007HFM micro-focus X-ray generation system (direct drive, high frequency rotating anode generator). The S-MAX 3000 pinhole SAXS camera design includes a high brilliance X-ray source and a 3-meter, fully evacuated camera length, which provides both high intensity and high resolution. Coupled with a fully integrated two-dimensional multi-wire proportional counter, the system is capable of making highly sensitive measurements for both isotropic and anisotropic materials. The Rigaku S-MAX 300 possesses high brilliance, is user friendly, and requires significantly low maintenance costs to maintain high levels of operation over a long lifetime.

List of Publications Under This Grant

The funds for this project were used exclusively to purchase the requested equipment. The new equipment provides characterization for several ARO/ARL-funded research projects in the PI's laboratory, where a number of publications will be submitted shortly. This equipment will continue to provide characterization capabilities for the PI's laboratory and many other polymer researchers at Texas A&M University and beyond for many years to come, where many more publications will result.