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The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT
This proposal seeks support for purchasing a Wyatt triple detection system to append to an existing gel permeation chromatograph (GPC) for characterizing synthetic polymers. The triple detection system consists of (i) an Optilab TrEX refractometer, (ii) a Viscostar II viscometer, and (iii) a Dawn Heleos 8 multi-angle light scattering detector. Combining these instruments with our existing GPC will give us the capability to (i) determine the absolute molecular weights of polymers that we are designing in our ARO- and DTRA-sponsored efforts, which is essential for correlating small molecular changes of the polymers to changes in the macroscopic properties of materials; (ii)

15. SUBJECT TERMS
depolymerization, triple detection, GPC, SEC, self-immolative, depolymerizable polymers

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Scott Phillips
UU	UU	UU	UU		19b. TELEPHONE NUMBER 814-867-2502

Report Title

Final Report: Triple Detection System for Characterization of Depolymerizable Polymers

ABSTRACT

This proposal seeks support for purchasing a Wyatt triple detection system to append to an existing gel permeation chromatograph (GPC) for characterizing synthetic polymers. The triple detection system consists of (i) an Optilab TrEX refractometer, (ii) a Viscostar II viscometer, and (iii) a Dawn Heleos 8 multi-angle light scattering detector. Combining these instruments with our existing GPC will give us the capability to (i) determine the absolute molecular weights of polymers that we are designing in our ARO- and DTRA-sponsored efforts, which is essential for correlating small molecular changes of the polymers to changes in the macroscopic properties of materials; (ii) characterize physical properties of the polymers (namely, the radius of gyration and hydrodynamic radius); and (iii) characterize the molecular weight and branching density of branched polymeric systems. Additionally, the triple detection system also will (i) accelerate current collaborative efforts with Ayusman Sen's group (a DTRA-sponsored project) at the Pennsylvania State University; (ii) position graduate students and postdoctoral fellows conducting the research at the forefront of polymer characterization techniques; and (iii) expose undergraduate chemistry students (who enroll in an existing advanced organic laboratory course) to aspects of polymer chemistry and state-of-the-art polymer characterization.

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

My count refers to oral presentations in which I discussed our work that used the triple detection system for characterizing polymers. There are no papers or extended abstracts to submit for these presentations.

Number of Presentations: 20.00

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

2016 Best presentation, ACS Industrial & Engineering Chemistry Research, 252nd ACS National Meeting
2016 MSMLG Czarnik Emerging Investigator Award
2016 Selected as the Adhesion Society's 2016 Distinguished Paper
2015 Analytical Methods Emerging Investigator
2015 Polymer Chemistry Emerging Investigator
2015 The Arthur F. Findeis Award for Achievement by a Young Analytical Scientist

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

The funded triple detection system was attached to our GPC towards the end of October, 2015. It has revolutionized our analysis of polymer lengths, dispersity, and even provides indicators of polymer tertiary structure. The detector is essential for unpublished work on depolymerizable hyper branched polymers, as well as obtaining molecular weights for new classes of depolymerizable polymer that we are designing and preparing. We anticipate that this detection system will advance our work sponsored by ARO, DTRA, and NSF.

To date, we have not published work that employs the triple detection system, although we are currently drafting five manuscripts. This work includes (i) depolymerizable polymer debondable adhesives; (ii) mechanistic studies on debondable adhesives; (iii) depolymerizable poly(pyrrole)s; (iv) depolymerizable poly(isocyanate)s; and (v) depolymerizable poly (glyoxamide)s. We will share experimental results/details once these (and other) manuscripts are accepted for publication.

Technology Transfer

none