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					19b. TELEPHONE NUMBER 412-268-3128

RPPR Final Report
as of 03-Jan-2019

Agency Code:

Proposal Number: 73036CHCF

Agreement Number: W911NF-18-1-0130

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Report Date: 31-Dec-2018

Date Received: 18-Dec-2018

Final Report for Period Beginning 05-May-2018 and Ending 31-Dec-2018

Title: US-Japan Workshop on Advances in Organic/Inorganic Hybrid Materials

Begin Performance Period: 05-May-2018

End Performance Period: 30-Apr-2019

Report Term: 0-Other

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STEM Degrees:

STEM Participants:

Major Goals: The goal of this proposal was to bring together scientists from the US and Japan for a workshop to discuss breakthroughs at the interface of organic and inorganic polymers. The symposium is called the US-Japan Advances in Organic-Inorganic Hybrids Materials. This type of symposium brings together young and established scientists from a number of sub-disciplines to have an opportunity to discuss their work. It is a single session event (all talks in the same room) to promote discussion, interaction of all participants and foster future collaboration between these two countries.

Accomplishments: PDF Attached.

Training Opportunities: In order to promote training and professional development for students and postdocs, a poster session was held. A large number of the participants in the meeting were students and postdocs. Several prizes were awarded to the best presenters to encourage them in their research work. The best poster prizes were announced on the final day of the workshop.

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: Kevin JT Noonan

Person Months Worked: 1.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Funding Support:

RPPR Final Report
as of 03-Jan-2019

Final Report
Request for Symposia Support: US-Japan Workshop on Advances in Organic/Inorganic Hybrid Materials

Principal Investigator:	Kevin J. T. Noonan
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Proposal Number:	73036CHCF
Agreement Number:	W911NF-18-1-0130
Period Covered by Report:	05/01/2018 – 04/30/2019
Author of Report:	Kevin J. T. Noonan

Summary

For over 25 years, the *US-Japan Workshop on Advances in Organic/Inorganic Hybrid Materials* has enabled researchers from the United States and Japan to meet and discuss emerging concepts in inorganic polymers, organic/inorganic hybrids and nanocomposite materials. These workshops have been highly successful in stimulating collaborations between these two countries. The meetings are held every three years and alternate between the US and Japan.

The workshop was a great success, and many thanks are due to the ARO for their support. This symposium was held at Rutgers University, Newark campus on June 17th-21st, 2018. A strong effort was made to bring together well-established colleagues with younger scientists and graduate students who can benefit from their experience. The symposium in its entirety consisted of 39 talks over 3 full days. A poster session to include students and postdocs was held for training and professional development. The list of participating speakers is included below.

Invitees

Harry Allcock (Penn State University)
Yoshiki Chujo (Kyoto University)
Francois Ganachaud (NCRS INSA Lyon)
Joe Gilroy (Western University, Canada)
Masayuki Gon (Kyoto University)
Takahiro Gunji (Tokyo University of Science)
Frieder Jaekle (Rutgers University)
Yoshiro Kaneko (Kagoshima University)
Rebekka Klausen (Johns Hopkins University)
Hilmar Koerner (Air Force Research Labs)
Masashi Kunitake (Kumamoto University)
Rick Laine (University of Michigan)
KiBum Lee (Rutgers University)
Christine Luscombe (University of Washington)

Kimihiko Matsukawa (Kyoto Institute of Technology)
Kris Matyjaszewski (Carnegie Mellon University)
Kensuke Naka (Kyoto Institute of Technology)
Kevin Noonan (Carnegie Mellon)
Dawanne Poree (US Army Research Office)
Jeff Pyun (University of Arizona)
Yang Qin (University of New Mexico)
Joji Ohshita (Hiroshima University)
Ayako Oyane (AIST)
Stuart Rowan (University of Chicago)
Shigeru Shimada (AIST)
Atsushi Shimojima (Waseda University)
Yoshiyuki Sugahara (Waseda University)
Kazuo Tanaka (Kyoto University)
Chuanbing Tang (University of South Carolina)
Ikuyoshi Tomita (Tokyo Institute of Technology)
Satoru Tsukuda (Hiroshima University)
Seiji Watase (Osaka Research Institute)
Marcus Weck (New York University)
Uli Wiesner (Cornell University)
Ken Wynne (Virginia Commonwealth University)
Yoshihiro Uozo (Mitsubishi Chemical)

Topics Covered

New Synthetic Approaches to Organic-Inorganic Hybrid Materials. This session described strategies to synthesize new hybrid materials including: functionalization methods for polyphosphazenes, supramolecular approaches to hybrid materials, and reactive polymers as intermediates to build new materials.

Conjugated Hybrid Materials for Optoelectronic Applications. This session highlighted the incorporation of inorganic elements into conjugated materials for optoelectronic applications. These include a wide range of elements: B, Al, Ga, Si, Ge, Sn, P and As, as well as transition metals. The application of some of these materials in devices and sensing applications was disseminated in these presentations.

Nanomaterials and Nanocomposites. This session described novel approaches to inorganic nanomaterials in addition to composites with organic materials. Nanostructured hybrid materials are of key interest in areas related to energy conversion ranging from batteries to light harvesting and catalysis.

Materials and Device Applications. This session focused on the materials and device applications of films, fibers, and bulk materials. Several areas were highlighted: high refractive index materials for IR optics, photoresponsive materials, polymers with tailored surface properties, and ion-conducting materials for fuel cells.

Self-Assembly and Biomedical-Related Applications. The final session described organic-inorganic hybrid materials with biological relevance. For example, hybrid oxide materials used for cancer imaging and targeting, as well as cationic metallocenium moieties in novel polymeric materials are promising as new antimicrobial coatings.

Relation to ARO

The materials discussed at this symposium have a wide range of applications. This includes stationary and portable power applications including batteries, fuel cells and solar cells. Conjugated materials that are being developed will be potentially valuable as lightweight sensors incorporated into optical protective equipment for Army uniforms. Biosensors may also be possible to monitor the vital signs of soldiers. Overall, the proposed materials have potential application in chemical and biological sensing, energy conversion, and displays which are all relevant to the ARO's mission.

Chairpersons

The chairpersons/organizers for this symposium were:

Prof. Kevin Noonan, Carnegie Mellon University
Prof. Frieder Jaekle, Rutgers University – Newark
Prof. Jeff Pyun, University of Arizona

Prof. Joji Ohshita, Hiroshima University
Prof. Takahiro Gunji, Tokyo University of Science
Prof. Kensuke Naka, Kyoto Institute of Technology

Dissemination of Results

The symposium was available to any person or persons, foreign or domestic, who registered for the meeting. Technical abstracts were collected from all the participants and made available for everyone in the symposium.

Total Cost

This proposal requested \$7,000 to partially offset housing and registration costs incurred by invited speakers. This was transferred directly to the State University of New Jersey (Rutgers) to cover registration and accommodation for 14 of the invitees (\$500 per invitee).

Final Program

Below is the final program which was sent to the participants of the symposium.

Schedule at a Glance

10th US-JAPAN HYBRID MATERIALS WORKSHOP - RUTGERS UNIVERSITY NEWARK June 17-21, 2018

Day/Time	Sunday June 17th	Monday June 18th	Tuesday June 19th	Wednesday June 20th	Thursday June 21st	
8:00-8:30		Breakfast - Hotel	Breakfast - Hotel	Breakfast - Hotel	Breakfast - Hotel	
8:30-8:40		Registration (CU)				
		Introductory Remarks				
8:40-9:10		L1 - Chujo	L12 - Wiesner	L23 - Qin		
9:10-9:40		L2 - Allcock	L13 - Oyane	L24 - Tanaka		
9:40-10:10		L3 - Naka	L14 - Lee	L25 - Klausen		
10:10-10:40		Coffee Break	Coffee Break	Coffee Break		
10:40-11:00		SL1 - He	SL3 - Tsukada	SL6 - Pavanello		
11:00-11:30		L4 - Gunji	L15 - Lu	L26 - Luscombe		
11:30-12:00		L5 - Pyun	L16 - Kunitake	L27 - Tomita		
		Lunch Break	Lunch Break	Lunch Break		
1:20-1:50		L6 - Rowan	L17 - Wynne	L28 - Shimojima	Sightseeing Manhattan	
1:50-2:20		L7 - Watase	L18 - Matsukawa	L29 - Weck		
2:20-2:50		L8 - Gilroy	L19 - Tang	L30 - Kaneko		
2:50-3:10		SL2 - Gon	SL4 - Uozu	Coffee Break		
3:10-3:40		Coffee Break	Coffee Break	L31 - Poree		
3:40-4:10	Hotel Check-In	L9 - Laine	L20 - Matyjaszewski	L32 - Ohshita		
4:10-4:40		L10 - Shimada	L21 - Sugahara	L33 - Noonan		
4:40-5:10		L11 - Jaekle	L22 - Koerner			
5:10-5:30		Poster Setup	SL5 - Ganachaud			
5:30-6:30		Poster Session & Exhibit (refreshments)	Conference Photo	5:30 pm Bus Departure		
6:30-7:30		Buffet Dinner - Jazz 15 Washington Street	Dinner On Your Own	Maritime Parc Restaurant 6:30 pm Cocktail hour 7:30-9:30 pm Dinner		
7:30-8:30		Conference Registration and Welcome Reception University Club, Robeson				
8:30-9:30						

Welcome Reception: University Club, 2nd Floor of Paul Robeson Campus Center
All Lectures: Center for Law and Justice (CU) at Rutgers University Newark
 123 Washington Street, Lower Level, Room 070 McCarter & English Lecture Hall
Poster Session and Exhibit: 15 Washington Street, Great Hall

Conference Schedule

Sunday, June 17th

6:30-9:30 **Registration & Welcome Reception**
Paul Robeson Campus Center (PRCC), *University Club* (2nd floor, follow signs)
Shuttle Service from Robert Treat Hotel Starting from 6:00 pm

Monday am, June 18th

Session 1 **New Classes of Organic-Inorganic Hybrid Materials**
Session Chairs: Joji Ohshita, Kevin Noonan

8:30-8:40 **Welcome Remarks**
Frieder Jäkle, *Rutgers University*; Joji Ohshita, *Hiroshima University*

8:40-9:10 **Hybrid Materials Based on Element-Blocks**
Yoshiki Chujo, *Kyoto University*

9:10-9:40 **New Designs and Uses for Phosphazene High Polymers**
Harry R. Allcock, *The Pennsylvania State University*

9:40-10:10 **Functional Materials Based on Completely and Incompletely Condensed Cage-Silsesquioxanes**
Kensuke Naka, *Kyoto Institute of Technology*

10:10-10:40 Coffee Break (CLJ Atrium)

Session 2 **New Classes of Organic-Inorganic Hybrid Materials**
Session Chairs: Yoshiyuki Sugahara, Marcus Weck

10:40-11:00 **Short Talk: Microwave Enabled Fabrication of Carbon Nanomaterials and Their Metal Hybrids: Unique Structures and Their Applications**
Huixin He, *Rutgers University Newark*

11:00-11:30 **Preparation and Properties of Organic-Inorganic Hybrid Materials Using Titanium Phosphonate Cluster**
Takahiro Gunji, *Tokyo University of Science*

11:30-12:00 **Finding Light in the Darkness Using Chips: Ultra-High Refractive Index Polymers for Thermal Imaging and IR Optics**
Jeffrey Pyun, *University of Arizona*

12:00-1:20 Lunch Break (*on your own*)

Monday pm, June 18th

Session 3

New Synthetic Approaches

Session Chairs: Ikuyoshi Tomita, Jeff Pyun

- 1:20-1:50** **Using Metallosupramolecular Polymers as a Route to Poly[n]catenanes**
Stuart J. Rowan, *University of Chicago*
- 1:50-2:20** **Phosphorescent Materials using Rare Earth Element Sensitized by Coordination and Hybridization**
Seiji Watase, *Osaka Research Institute of Industrial Science and Technology (ORIST)*
- 2:20-2:50** **Hybrid Molecular and Macromolecular Materials Derived from Redox-Active Formazanate Ligands**
Joe B. Gilroy, *The University of Western Ontario*
- 2:50-3:10** **Short Talk: Novel π -Conjugated Materials Based on Boron-Fused AzoComplexes**
Masayuki Gon, *Kyoto University*
- 3:10-3:40** Coffee Break (CLJ Atrium)

Session 4

New Synthetic Approaches

Session Chairs: Takahiro Gunji, Rebekka Klausen

- 3:40-4:10** **Electrophilic Substitution on Phenylsilsesquioxanes, Recent Advances in Partial Cages and Polymers**
Richard M. Laine, *University of Michigan*
- 4:10-4:40** **Controlled Synthesis of Oligo- and Polysiloxanes**
Shigeru Shimada, *National Institute of Advanced Industrial Science and Technology (AIST)*
- 4:40-5:10** **Organoboron Polymers as Functional Hybrid Materials**
Frieder Jäkle, *Rutgers University Newark*
- 5:10-5:30** Poster Setup
- 5:30-7:30** **Poster Session** 15 Washington Street, **Great Hall**
Refreshments will be served
- 7:30-9:30** **Buffet Dinner** 15 Washington Street, **Great Hall**
All are welcome !

Tuesday am, June 19th

Session 5

Biomedical Applications

Session Chairs: Yoshiro Kaneko, Chuanbing Tang

8:40-9:10

Self-assembly based Organic-Inorganic Hybrid Materials: From Fundamentals to Applications

Uli Wiesner, Cornell University

9:10-9:40

Supersaturated Solution Process for the Fabrication of Calcium Phosphate-Based Hybrids for Biomedical Applications

Ayako Oyane, Institute of Advanced Industrial Science and Technology

9:40-10:10

Bio-Inspired Nanomaterials to Control Stem Cell Fate and Function

KiBum Lee, Rutgers University

10:10-10:40

Coffee Break (CLJ Atrium)

Session 6

Thermal and Adhesive Applications

Session Chairs: Atsushi Shimojima, Rick Laine

10:40-11:00

Short Talk: Preparation of Free-standing Films from Bridged Polysilsesquioxanes and Their Thermal Properties

Satoru Tsukada, Hiroshima University

11:00-11:30

A New Class of Submolecular Switches Based on the DBCOD Conformational Change

Jennifer Lu, UC Merced

11:30-12:00

Necklace-shaped Dimethylsiloxane Polymers Bearing Polyhedral Oligomeric Silsesquioxane Cages as a Hot-Melt Adhesive

Masashi Kunitake, Kumamoto University

12:00-1:20

Lunch Break (*on your own*)

Tuesday pm, June 19th

Session 7

Advanced Materials Applications

Session Chairs: Masashi Kunitake, Jennifer Lu

1:20-1:50

Easy Functionalization of "Pt cured" Polydimethylsiloxane Elastomers

Kenneth J. Wynne, *Virginia Commonwealth University*

1:50-2:20

Preparation of Polysilsesquioxane Thin Films Dispersing Metal Nanoparticles and their Applications

Kimihiro Matsukawa, *Kyoto Institute of Technology*

2:20-2:50

Metallocene Polymers: Controlled Polymerization and Advanced Materials

Chuanbing Tang, *University of South Carolina*

2:50-3:10

Short Talk: Continuous Roll Imprinting of Moth-Eye Antireflection Surface Using Anodic Porous Alumina and Multi-functionalities on the Moth-eye Surfaces

Yoshihiro Uozu, *Mitsubishi Chemical Corporation*

3:10-3:40

Coffee Break (CLJ Atrium)

Session 8

Nanomaterials and Nanocomposites

Session Chairs: Kensuke Naka, Stuart Rowan

3:40-4:10

New Hybrid Materials by ATRP

Krzysztof Matyjaszewski, *Carnegie Mellon University*

4:10-4:40

Preparation of Organic-Inorganic Hybrid Materials Using Inorganic Nanostructures

Yoshiyuki Sugahara, *Waseda University*

4:40-5:10

Polymer Nanocomposites and Hybrids in Additive Manufacturing

Hilmar Koerner, *Air Force Research Laboratory*

5:10-5:30

Short Talk: Silicone resins as additives in silicone elastomers: Lousy hybrid oligosiloxanes for large potential applications!

François Ganachaud, *CNRS INSA-Lyon & COMPASS Lab CNRS UPenn*

5:30-5:50

Conference Photo (outside CLJ)

Wednesday am, June 20th

Session 9

Conjugated Hybrid Materials for Optoelectronics

Session Chairs: Kimihiro Matsukawa, Christine Luscombe

8:40-9:10

Pt-Containing Conjugated “Roller-Wheel”-Shaped Materials for Organic Photovoltaic (OPV) Applications

Yang Qin, *University of New Mexico*

9:10-9:40

Luminescent Chromic Sensors Based on Excitation-Driven Boron Complexes

Kazuo Tanaka, *Kyoto University*

9:40-10:10

Poly(cyclosilane)s: Hybrid Conjugated Polymers Inspired by Crystalline Silicon

Rebekka S. Klausen, *Johns Hopkins University*

10:10-10:40

Coffee Break (CLJ Atrium)

Session 10

Conjugated Hybrid Materials for Optoelectronics

Session Chairs: Kazuo Tanaka, Yang Qin

10:40-11:00

Short Talk: The Embedded Quantum ESPRESSO Software Package

Michele Pavanello, *Rutgers University Newark*

11:00-11:30

Chalcogen Polymers for Completely Solution-Processed Inorganic Photovoltaics

Christine K. Luscombe, *University of Washington*

11:30-12:00

π -Conjugated Elements-block Polymers by Post-element-transformation Technique

Ikuyoshi Tomita, *Tokyo Institute of Technology*

12:00-1:20

Lunch Break (*on your own*)

Wednesday pm, June 20th

Session 11 Self-Assembly and Network Formation

Session Chairs: Seiji Watase, Uli Wiesner

- 1:20-1:50** **Self-healing Mesostructured Silica- and Silsesquioxane-based Films**
Atsushi Shimojima, *Waseda University*
- 1:50-2:20** **Directed Self-Assembly and Crystallization of Polymeric Colloids**
Marcus Weck, *New York University*
- 2:20-2:50** **Facile Preparation of Ammonium-Functionalized POSS and Cyclotetrasiloxane Using Superacid Catalyst and Their Application to Hybrid Hydrogels**
Yoshiro Kaneko, *Kagoshima University*
- 2:50-3:10** Coffee Break (CLJ Atrium)

Session 12 Advanced Hybrid Materials Applications

Session Chairs: Yoshiki Chujo, Kris Matyjaszewski

- 3:10-3:40** **Polymer Science for the Next Generation Warfighter**
Dawanne Poree, *Army Research Office*
- 3:40-4:10** **Bridged Silica Membranes for Water Desalination**
Joji Ohshita, *Hiroshima University*
- 4:10-4:40** **Phosphorus-Based Main Group Cations for Hydroxide Resistant Membrane Materials**
Kevin J. T. Noonan, *Carnegie Mellon University*

5:30 **Bus Departure to Liberty State Park from Robert Treat Hotel**

6:30-7:30 **Cocktail Reception** Maritime Parc, Liberty State Park

7:30-9:30 **Conference Banquet** Maritime Parc, Liberty State Park

9:30-10:30 **Bus Transportation to Robert Treat Hotel**

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