

# College of Science and Health

## SABBATICAL LEAVE APPLICATION

University of Wisconsin-La Crosse

Name: Aric Opdahl

Telephone Number: 608-785-8274

Rank: Associate Professor

Department: Chemistry and Biochemistry

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Title of Project: Completing manuscripts for an NSF project, building international collaborations, and developing new research directions in the area of DNA biosensors

Dates of Project: 1/20/2015 – 5/24/2015

Locations of Project: UW-L; I.N.L. Braga, Portugal; University of Heidelberg, Germany

Date of Last Leave: None

Date of Last Sabbatical: None

Requesting: (check one)

Two (2) semesters

One (1) semester

Fall  Spring

Please Check here that the following are included or are not applicable:

Current, brief CV

Letter of support from Department Chair

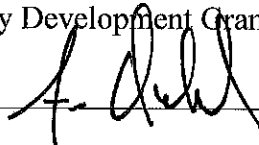
Table of sabbatical costs and possible funding sources

Letters of support from collaborators

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Should funds (in addition to salary) be required to support this sabbatical proposal, I have also appended a Faculty Development Grant Proposal.

Applicant's Signature

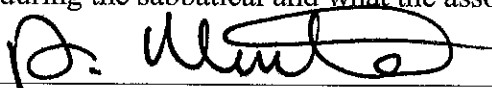


Date

9/12/13

I have sent a letter to the Dean of the College of Science and Health indicating how courses would be covered during the sabbatical and what the associated department costs would be.

Chair's Signature



Date

9/12/13

## I Abstract of Project

The primary activities that will be performed during this proposed sabbatical leave are to complete an ongoing NSF-funded project (2012-2015) in the area of biosensor development and to develop new areas of research for my undergraduate research program. The proposed sabbatical would occur during the final year of this three-year grant, and would provide the necessary time to focus on writing manuscripts, while completing experimental work and developing new research directions for continued funding. Tangible outcomes will be a set of manuscripts submitted for peer-reviewed publication in *American Chemistry Society (ACS) Journals* and a renewal proposal to be submitted to the NSF. Additionally, the sabbatical leave will provide an opportunity to work directly with my current collaborators at the Iberian International Nanotechnology Laboratory (INL, Braga, Portugal) and the University of Heidelberg (Heidelberg, Germany).

## II Introduction

My undergraduate research program is focused on understanding the physical properties of short DNA strands attached to solid surfaces. These types of surfaces are widely used as sensors in genetic diagnostics. In a traditional sensor, discrete regions of the sensor surface are coated with multiple copies of single-stranded DNA *probes*. The probe-coated regions act as sensors by associating with complementary *target* DNA strands that are captured from the surrounding solution. In our lab, we perform fundamental measurements to better understand how surface attachment alters the abilities of DNA to form these hybrids. Work in this area is important for the development of new DNA-surface technologies and new medical diagnostic tools.

The physical property we are currently focused on with three-year NSF funding is quantifying how attachment to a surface affects the *stability* of hybridized DNA (e.g., once a *probe: target* hybrid forms, how robust is it?). While there are several established ways to assess stability of DNA hybrids in a dilute solution, usually by heating the solution to measure a thermal denaturation profile for the DNA hybrid and determine the thermal denaturation temperature ( $T_m$ ), the tools for performing this type of measurement on a surface do not exist. We are developing the analytical instrumentation needed to perform these measurements and performing experiments to understand how a wide range of experimental variables affect the  $T_m$ . Knowledge of this information will potentially improve both the selectivity and sensitivity of DNA biosensors.

During the first year (9/2/2012 – 9/1/2013) of the grant period, the three undergraduate students working with me designed and built a custom surface plasmon resonance imaging spectrometer (SPR), which will be the main tool we will use. The instrument is unique in that there are no commercial SPR instruments capable of incorporating the automated temperature ramps (heating from 20° to 75° C) needed to monitor  $T_m$  of DNA on surfaces. This year, we are transitioning to a period of intense data collection, from

SPR measurements and additional techniques, along with our collaborators at the Iberian International Nanotechnology Laboratory (INL, Braga, Portugal). We are beginning to develop a manuscript based on a dataset obtained from an older SPR unit in our lab, which is capable of providing semi-quantitative data over a much smaller temperature range (25° to 60° C). Our expectation is that we will have the data needed for 2-3 complete manuscripts from the new SPR instrument by the end of the second grant year (9/1/2014).

The scope of the NSF project is large, and many of the individual steps are time consuming, since we are developing new methods to make measurements. Additionally, most of the tasks that the undergraduate researchers are performing are at the level of graduate work. Thus the primary obstacle to successfully completing the overall project on schedule is time. While we are on track with much of the experimental work, it will be challenging to balance writing manuscripts and a competitive renewal proposal to the NSF along with regular faculty duties, even taking into consideration summer and J-term.

The goals of the sabbatical are to strengthen the foundation of my undergraduate research program by:

- Completing and disseminating work resulting from the NSF project within the three year grant period.
- Enhancing international collaborative activities with the INL (Portugal) and the University of Heidelberg (Germany).
- Developing new research directions which will be submitted as a proposal for continued funding.

### **III Project Description**

#### **Manuscript Development**

The sabbatical period will provide time needed to complete manuscripts for three project lines. Note that in the following it is assumed that most experimental data needed to support these manuscripts will have been obtained by January 2015. If not, we will continue experimental work in these same areas while preparing manuscripts.

**Manuscript 1: New methods for measuring  $T_m$  of DNA hybrids on surfaces.** This project area is analytical in nature, focused on creating experimental methodologies for determining  $T_m$  from DNA hybrids on surfaces using our newly built SPR. Since this SPR instrument has unique features, any interpretations that we derive from the data need to be validated through extensive control experiments.

To accomplish this, we are characterizing the influences of several parameters whose effects on the  $T_m$  of DNA in solution are known, including ionic strength, heating rate, nucleotide content, hybrid length, and nucleotide mismatches. The results are compared to measurements of DNA in dilute aqueous solution using established methods. Because

the SPR methodology will be novel, we anticipate the manuscript based on these control experiments will be publishable in a high-impact journal such as the ACS journal, *Analytical Chemistry*.

**Manuscript 2: Understanding how DNA-substrate interactions affect stability.** The second project area is physical in nature, focusing on measuring how chemical interactions with the underlying surface influence the  $T_m$  of DNA hybrids. We are using strategies which we have previously published on to prepare DNA hybrid and surfaces that have varied DNA-substrate interactions. We have performed a preliminary set of measurements with our existing (older) SPR and observed that surface interactions qualitatively weaken DNA hybrids. Thermal denaturation profiles will be obtained using our new SPR from which the  $T_m$  will be determined. The target journal for this manuscript would be the ACS Journal, *Langmuir*.

**Manuscript 3: Understanding how DNA-DNA interactions affect stability.** The third line is also physical. It is widely observed that DNA probe density has a strong effect on hybridization activity, with hybridization efficiencies decreasing as the surface density of probes increases. In densely packed DNA probe films, therefore, interactions between adjacent DNA probes and hybrids may reduce hybrid stability, via electrostatic mechanisms (DNA is negatively charged). SPR will be used to quantitatively measure  $T_m$  of DNA hybrids as surface density is systematically varied using strategies we have developed in our lab. The target journal for this manuscript would be the ACS Journal, *Langmuir*.

### **International Collaboration**

**International Iberian Nanotechnology Laboratory.** The sabbatical period will provide increased opportunity for international collaboration with investigators at the International Iberian Nanotechnology Laboratory (INL) in Braga, Portugal. Dr. Dmitri Petrovykh (INL) and I have a long history of collaboration, most recently resulting in two co-published manuscripts with undergraduate coauthors from UW-L.<sup>1,2</sup> One of the strengths of our research approach is that we use multiple complementary instrumental techniques to analyze DNA thin films. The main complementary measurement provided through INL is advanced imaging X-ray photoelectron spectroscopic (XPS) analysis of DNA films. Dr. Petrovykh is a renowned expert in photoelectron spectroscopy.

While Dr. Petrovykh and I have collaborated very well independently, communicating electronically or by phone, there are distinct advantages to an on-site collaboration visit (approximately three weeks) during the sabbatical period, particularly with respect to developing new project lines. One objective for me during such a visit would be to learn advanced techniques for XPS analysis of DNA thin films. UW-L recently acquired an XPS system and some of the techniques used at INL could be applied to UW-L's instrument. Additional techniques available at INL include a combination imaging ellipsometer/QCM, which like XPS, has methods developed at INL that could be translated to versions of these instruments owned by UW-L.

*University of Heidelberg.* The sabbatical period will also provide an opportunity to work with Dr. Michael Zharnikov in the Applied Physical Chemistry Department at the University of Heidelberg, Germany. I have recently (2009-2010) collaborated with Dr. Zharnikov which resulted in one coauthored manuscript with UW-L student coauthors.<sup>1</sup> Dr. Zharnikov is a renowned expert in the area of NEXAFS (near edge x-ray absorption fluorescence spectrometry), another complementary surface analysis technique, however one which requires access to advanced synchrotron radiation sources. An objective of this visit would be to participate in a set of NEXAFS experiments with Dr. Zharnikov's group (focused on DNA) and to develop a set of future experiments to be performed in collaboration with UW-L undergraduates. This approximately one week trip would occur alongside the trip to INL. (approximately 4 weeks total).

### *Developing New Research Directions*

The sabbatical period will allow an opportunity to expand my research directions at UW-L. One of the things I have noted while working at UW-L is that while the quality of the output from my lab has improved steadily over time, the focus of my projects has remained relatively narrow. The sabbatical period will provide time to develop new techniques and research directions, some within the area of DNA biosensors and others in the areas of protein sensors and biosensor support materials (coatings). For example, from my graduate work I have a strong background in polymer and hydrogel thin film analysis. I would like to develop a project studying incorporation and activity of DNA and protein embedded in hydrogel thin films. An example of a technique that I would like to pursue is modifying our new SPR instrument to provide fluorescence measurements. This is a technique that is related to SPR, called Surface Plasmon Enhanced Fluorescence Spectroscopy, and provides a different type of information than SPR. I would plan to use the technique to study other types of folded DNA, which cannot be studied by conventional SPR analysis, yet are exciting potential probes for next generation biosensors (e.g. DNA biosensors that can detect proteins and antigens).

### *NSF Renewal Proposal*

Together, the three manuscripts and the development of new research directions will provide the basic material for a renewal proposal for NSF support. This complete proposal would be prepared to be submitted to the NSF in Summer 2015.

## **IV How the project meets UW System Sabbatical Guidelines**

This proposal addresses aspects of the UW System Shared Learning Goals highlighted in the sabbatical guidelines. Three points deal with my ongoing research and subsequent publications: “**Knowledge of human cultures and the natural world**”, “**Interdisciplinary activity**”, and “**Collaborative program activities**”. My research provides knowledge of the natural world by providing fundamental information regarding

the behavior of biomolecules at interfaces. The research is by nature interdisciplinary, as I currently work with professional physicists and undergraduate students with interests ranging from Biology to Physics. Additionally, the project includes enhancing collaboration with international scientists at INL and the University of Heidelberg.

## V How the project meets CSAH Sabbatical Guidelines

This sabbatical proposal relates directly to two SAH guidelines: “**The sabbatical project should enhance teaching, course and curriculum development and/or research or any other scholarly activities related to instructional programs within the field of expertise**”, and “**The sabbatical project should lead to results that are publishable in a reputable journal**”. This project directly advances a set of research goals within my field of expertise. The sabbatical project includes developing new types of experimental measurements of DNA on surfaces. Additionally the sabbatical project is expected to lead to results that are publishable in American Chemical Society (ACS) Journals, highly-rated peer-reviewed journals in the field of chemistry.

## VI Estimated Budget

The only funds that would be required for this sabbatical would be supplemental funds for international travel to INL and University of Heidelberg. I will use funds associated with the department indirect accounts that were setup with this grant. These accounts are projected to have accrued > \$6000 at the time of the sabbatical. An International Development Fund proposal will be submitted Fall 2014 for additional anticipated expenses. Maximum awards for IDF grants are currently \$3350.

## VII References

1. Impact of Nucleotide-Surface Interactions on the Stability of DNA Hybrids; Sarah M. Schreiner; Anna L. Hatch David F. Shudy; David R. Howard; Caitlin Howell; Jianli Zhao; Patrick Koelsch; Michael Zharnikov; Dmitri Y. Petrovykh; Aric Opdahl; *Analytical Chemistry* **2011**; 83; 4288-4295. *Journal impact factor:5.856*
2. Controlled and Efficient Hybridization Achieved with DNA Probes Immobilized Solely through Preferential DNA-Substrate Interactions; Sarah M. Schreiner; David F. Shudy; Anna L. Hatch; Lloyd J. Whitman; Dmitri Y. Petrovykh; Aric Opdahl; *Analytical Chemistry* **2010**; 82; 2803-2810. *Journal impact factor:5.856*

UNIVERSITY of WISCONSIN  
**LA CROSSE**

AARON MONTE, PH.D., Professor & Chair  
4001 Cowley Hall | 608.785.8260 | amonte@uwlax.edu

10 September 2013

Sabbatical Review Committee  
College of Science and Health  
University of Wisconsin–La Crosse

To the Review Committee,

With this letter, I indicate my very strongest support for the sabbatical leave application of **Dr. Aric Opdahl**. Dr. Opdahl joined the Department of Chemistry and Biochemistry in the fall of 2005, and over the intervening eight years has grown to be a highly valued departmental colleague. Aric was promoted to Associate Professor in 2009 and tenured in 2010. His teaching load has included freshman-level General Chemistry (CHM 104/104L), sophomore-level Analytical Chemistry (CHM 301/301L), and the important upper level elective course, Instrumental Analysis (CHM 441), for which he developed all new modern content. His teaching efforts have strengthened our major's curriculum at virtually all levels. Aric also has built an impressive research program here, securing a relatively large amount of external funding to support both his own work as well as the acquisition of several pieces of modern instrumentation for the department and college. For example, his research is currently supported by a three-year 2012-2015 \$272k NSF grant, which is partially the subject of this application. Dr. Opdahl advises a number of majors pursuing the B.S. degree in Chemistry with ACS Certification.

Dr. Opdahl proposes to use his sabbatical leave primarily for the purpose of preparing and submitting for publication three manuscripts that detail the results he will have obtained through his NSF-funded research. In addition, he aims to strengthen his international collaborations with colleagues in both Portugal and Germany by visiting their laboratories and working to develop some complementary new experiments and techniques with them. Finally, as this sabbatical leave would occur during the last year of Aric's current funding, it will allow critical time for him to determine new research directions that will be the subject of proposal(s) for continued external funding. Clearly, this sabbatical leave would greatly enhance Dr. Opdahl's professional development as a physical/analytical chemist and thereby bring new expertise in cutting edge experiments back to our department and students. I am therefore highly supportive of this request and strongly recommend leave for Dr. Opdahl during the Spring 2015 semester.

As a final note, I will mention that one of my own goals for our department is to begin having many more faculty members take sabbatical leaves than in the past. Historically, very few of our chemists have pursued sabbaticals, and this has unfortunately created a culture in which not many faculty members consider taking these beneficial leaves. I have therefore been encouraging more people to apply. With our staffing levels closer to where they should be, I now hope that we can see one or two chemists taking sabbatical leaves each year for the next few years.

Sincerely yours,



Aaron Monte, Ph.D.  
Professor & Chair

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**Braga, September 4, 2013**

To whom it may concern:

I have collaborated with Prof. Opdahl for nearly a decade on design and characterization of DNA-functionalized surfaces. While during that time both of us have moved between research institutions, we have maintained a productive collaboration, based in part on our complementary expertise and research philosophies. Our collaboration so far has resulted in several high-impact publications (>150 cumulative citations in 7 years) and I am looking forward to continued work with Aric and I believe that an opportunity to host him for a sabbatical visit at the INL will strengthen the collaboration between our groups.

Our collaborative research has been directed at elucidating and exploiting the unique properties of custom-designed DNA-functionalized surfaces. An intrinsic challenge in this work is an irreducible level of ambiguity and/or uncertainty associated with any single measurement methodology; addressing this challenge requires the development and validation of multiple complementary analytical methods, which is one of the focal points of my collaboration with Prof. Opdahl. Advanced instrumentation available at the INL, including an imaging ellipsometer, and X-ray photoelectron spectroscopy (XPS) system, and a combined ellipsometry and quartz crystal microbalance (QCM) system, can provide important complementary information to that obtained by Aric on the advanced surface plasmon resonance (SPR) imaging system developed in his group. Sharing both instrumental and analytical expertise is an important objective that can be accomplished during Aric's sabbatical visit more effectively than over virtual means of collaboration.

Dr. Dmitri Petrovykh  
Principal Investigator, Biointerface Group Leader  
INL





**ANGEWANDTE PHYSIKALISCHE CHEMIE  
AM PHYSIKALISCH CHEMISCHEN INSTITUT  
DER UNIVERSITÄT HEIDELBERG**

ANGEW. PHYS. CHEMIE • 69120 HEIDELBERG • IM NEUENHEIMER FELD 253

Prof. Dr. Michael Zharnikov  
Surface Analysis Group

To the Sabbatical Review Committee

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[Michael.Zharnikov@urz.uni-heidelberg.de](mailto:Michael.Zharnikov@urz.uni-heidelberg.de)

Heidelberg, 05.09.2013

*Subject: a visit of Prof. Aric Opdahl*

I am writing to support Prof. Aric Opdahl's proposed visit with my research group at the University of Heidelberg during his sabbatical next year. My research group has successfully collaborated with Aric in the past. This collaborative research focused on multi-technique analysis of DNA thin films and resulted in a publication in the American Chemical Society Journal, Analytical Chemistry.

While Aric's group at the University of Wisconsin-La Crosse focuses on SPR, a technique that allows for in situ analysis of DNA films, our group at Heidelberg focuses on the complementary ex situ analysis of such films by advanced spectroscopic techniques (including synchrotron-based ones) as well as on fabrication of DNA arrays by electron beam and UV light lithography.

I look forward to developing new collaborative experiments with Aric in the areas in which our interests overlap. An opportunity to work with him directly for a short time during his sabbatical will be beneficial in this respect.

Best regards,

Prof. Dr. M. Zharnikov

Associate Professor  
Department of Chemistry  
University of Wisconsin-La Crosse 54601

**Education**

Ph.D.; Physical Chemistry; University of California-Berkeley; 2003

Dissertation title: Sum frequency generation (SFG) surface vibrational spectroscopy and atomic force microscopy (AFM) studies of the composition, structure, and mechanical behavior of polymers at interfaces.

Research advisor: Professor Gabor A. Somorjai

B.S.; Chemistry and Anthropology; University of Wisconsin-Madison; 1996

**Professional Experience**

Associate Professor; Department of Chemistry; University of Wisconsin-La Crosse; 54601; 2009-current

Assistant Professor; Department of Chemistry; University of Wisconsin-La Crosse; 54601; 2005-2009

NRC Postdoctoral Research Fellow; Process Measurements Division; Chemical Science and Technology Laboratory; National Institute of Standards and Technology (NIST); Gaithersburg; MD; 2003-2005

**Research interests**

Bio-interfaces; characterization of the physical properties of surfaces and interfaces; surface spectroscopy; surface electrochemistry; chemical methods for attaching biological molecules to surfaces

**Teaching interests**

Analytical chemistry; scientific instrumentation

**Fellowships, Grants, Awards**

- National Science Foundation Chemistry RUI Grant: \$271,586 (2012-2015)
- UW-L Faculty Research Grant: \$10,800 (2012-2013)
- National Science Foundation MRI Grant: \$524,145 (2010-2013)
- Research Corporation Cottrell College Award: \$45,482 (2007-2009)
- UW-L Faculty Research Grant: \$15,072 (2006-2007)
- National Research Council (NRC/NIST) Postdoctoral Fellowship (2003-2005)
- Rolf Schubert Distinguished Paper Award – Adhesion Society (2003)
- Teaching Assistant of the Year Award, Department of Chemistry, Univ. of Wisconsin – Madison (1997)
- I.B.M. Thomas J. Watson Memorial Scholarship (1991-1995)

**Publications**

Impact of Nucleotide-Surface Interactions on the Stability of DNA Hybrids; Sarah M. Schreiner; Anna L. Hatch David F. Shudy; David R. Howard; Caitlin Howell; Jianli Zhao; Patrick Koelsch; Michael Zharnikov; Dmitri Y. Petrovykh; Aric Opdahl; *Analytical Chemistry* **2011**; *83*; 4288-4295. *Journal impact factor:5.856*

Controlled and Efficient Hybridization Achieved with DNA Probes Immobilized Solely through Preferential DNA-Substrate Interactions; Sarah M. Schreiner; David F. Shudy; Anna L. Hatch; Lloyd J. Whitman; Dmitri Y. Petrovykh; Aric Opdahl; *Analytical Chemistry* **2010**; *82*; 2803-2810. *Journal impact factor:5.856*

Characterization and Controlled Properties of DNA Immobilized on Gold Surfaces; Hiromi Kimura-Suda; Aric M. Opdahl; Michael J. Tarlov; Lloyd J. Whitman; Dmitri Y. Petrovykh; *Kobunshi Ronbunshu (Japanese Journal of Polymer Science)* ; **2008**; 65; 46-57. *Invited Review*

Adsorption Behavior of DNA-Wrapped Carbon Nanotubes on Self-Assembled Monolayer Surfaces; Rebecca Zangmeister; James Maslar; Aric Opdahl; Michael Tarlov; *Langmuir*; **2007**; 23; 6252-6256. *Journal impact factor: 4.009*

Synthesis and Structural Characteristics of Glucopyranosylamide Films on Gold; Mridula Kadalbajoo; Juhee Park; Aric Opdahl; Hiromi Suda; Carolyn A. Kitchens; Jayne C. Garno; Michael J. Tarlov; Philip DeShong; *Langmuir*; **2007**; 23; 700-707. *Journal impact factor: 4.009*

Independent Control of Grafting Density and Conformation of Single-Stranded DNA Brushes; Aric Opdahl; Dmitri Petrovykh; Hiromi Kimura-Suda; Lloyd Whitman; Michael Tarlov; *Proceedings of the National Academy of Science* **2007**; 104; 9-14. *Journal impact factor: 9.598\**

Nucleobase Orientation and Ordering in Films of Single-Stranded DNA on Gold; Dmitri Petrovykh; Virginia Dieste-Perez; Aric Opdahl; Hiromi Kimura-Suda; Jay Sullivan; Michael Tarlov; Franz Himpfel; Lloyd Whitman; *Journal of the American Chemical Society* **2006**; 128; 2-3. *Journal impact factor: 7.885\**

Alkanethiols on Platinum: Multicomponent Self Assembled Monolayers; Dmitri Petrovykh; Hiromi Kimura-Suda; Aric Opdahl; Lee Richter; Michael Tarlov; Lloyd Whitman; *Langmuir* **2006**; 22; 2578-2587. *Journal impact factor: 4.009*

Combined AFM and Sum Frequency Generation (SFG) Studies of Polyolefins and Hydrogels at Interfaces; Aric Opdahl and Gabor A. Somorjai ACS Symposium Series 897: *Application of Scanned Probe Microscopy to Polymers* **2005**; 112-132. *Invited Review*

Solvent and Interface Induced Surface Segregation in Blends of Isotactic Polypropylene with Poly(ethylene-co-propylene); Aric Opdahl; Roger A. Phillips; Gabor A. Somorjai *Journal of Polymer Science B – Polymer Physics* **2004**; 42; 421-432. *Journal impact factor 1.739*

Hydrophobic Interaction Induced Ordering of Polymers at the Solid/Liquid Interface Studied by Infrared-Visible Sum Frequency Generation; Joonyong Kim; Aric Opdahl; Keng C. Chou; Gabor A. Somorjai *Langmuir* **2003**; 19; 9551-9553. *Journal impact factor: 4.009*

Humidity Dependence of the Surface Hydration and Mechanical Properties of Non-Ionic and Ionic Methacrylate Contact Lenses; Telly Koffas; Aric Opdahl; Telly Koffas; Chris Marmo; Gabor A. Somorjai *Langmuir* **2003**; 19; 3453-3460. *Journal impact factor: 4.009*

Surface Mechanical Properties of pHEMA Contact Lenses: Viscoelastic and Adhesive Property Changes on Exposure to Controlled Humidity; Aric Opdahl; Seong H. Kim; Telly Koffas; Chris Marmo; Gabor A. Somorjai *Journal of Biomedical Materials Research* **2003**; 67; 350-356. *Journal impact factor: 2.497*

Solvent Vapor Induced Ordering and Disordering of Phenyl Side Branches at the Air/Polystyrene Interface Studied by SFG; Aric Opdahl and Gabor A. Somorjai *Langmuir*; **2002**; 18; 9409-9412. *Journal impact factor: 4.009*

Effect of Bulk Miscibility on the Surface Composition of Polypropylene/Poly(ethylene-co-propylene) Blends; Aric Opdahl; Roger A. Phillips; Gabor A. Somorjai *Macromolecules* **2002**; 35; 4387-4396. *Journal impact factor: 4.411*

Surface Segregation of Methyl Side Branches Monitored by Sum Frequency Generation (SFG) Vibrational Spectroscopy For a Series of Random Poly(ethylene-co-propylene) Copolymers; Aric Opdahl; Roger A. Phillips; Gabor A. Somorjai *Journal of Physical Chemistry B* **2002**; 106; 5212-5220. *Journal impact factor: 4.086*

AFM and SFG Studies of pHEMA-Based Hydrogel Contact Lens Surfaces in Saline Solution: Adhesion, Friction, and the Presence of Non-Crosslinked Polymer Chains at the Surface; Seong H. Kim; Aric Opdahl; Chris Marmo; Gabor A. Somorjai *Biomaterials* **2002**; 23; 1657-1666. *Journal impact factor: 5.196*

Stretched Polymer Surfaces: Atomic Force Microscopy Measurements of the Surface Deformation and Surface Elastic Properties of Stretched Polyethylene; Aric Opdahl and Gabor A. Somorjai *Journal of Polymer Science B-Polymer Physics* **2001**; 39; 2263-2274. *Journal impact factor: 1.739*

Detection of Hydrophobic End Groups on Polymer Surfaces by Sum-Frequency Generation Vibrational Spectroscopy; Zhan Chen; Robert Ward; Y. Tian; Steve Baldelli; Aric Opdahl; Y. Ron Shen; Gabor A. Somorjai *Journal of the American Chemical Society* **2000**; 122; 10615-10620. *Journal impact factor: 7.885\**

**Estimated Budget**

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>ANTICIPATED COST</b>
Flight*	LSE to Porto, Portugal	\$960
Lodging and meals/expenses**	Max. per diem rate	\$190 × 21 days = \$3990
Flight*	Porto to Frankfurt	\$182
Lodging and meals/expenses**	Max. per diem rate	\$339 × 7 days = \$2373
	<b>TOTAL</b>	\$7505

\* Flight prices for Spring 2015 are not available, thus the anticipated cost is an estimate based on current rates for the same time period in Spring 2014.

\*\* Maximum U.S. Department of State per diem rates are listed for lodging, meals, and incidental expenses. Actual costs are expected to be significantly lower.

List Possible Sources of Additional Funding: (College funds are used only for salary.)

The only anticipated additional costs for this sabbatical are for travel to Braga, Portugal and Heidelberg, Germany.

NSF: I will primarily use funds associated with the department indirect accounts that were setup with this grant. These accounts are expected to have accrued > \$6000 at the time of the proposed sabbatical.

UW-L International Development Fund: An IDF proposal will be submitted for additional anticipated expenses. Maximum awards for IDF grants are currently \$3350.



**Foreign Per Diem Rates In U.S. Dollars**

**Country: PORTUGAL**  
**Publication Date: 09/01/2013**

Country Name	Post Name	Season Begin	Season End	Maximum Lodging Rate	M & IE Rate	Maximum Per Diem Rate	Footnote	Effective Date
PORTUGAL	Cascais	01/01	12/31	123	110	233	N/A	08/01/2013
PORTUGAL	Estoril	01/01	12/31	123	110	233	N/A	08/01/2013
PORTUGAL	Faial Island	04/01	10/31	122	83	205	N/A	08/01/2013
PORTUGAL	Faial Island	11/01	03/31	113	82	195	N/A	08/01/2013
PORTUGAL	Lisbon	01/01	12/31	164	107	271	N/A	08/01/2013
PORTUGAL	Madeira Islands	01/01	12/31	128	71	199	N/A	08/01/2013
PORTUGAL	Oeiras	01/01	12/31	123	110	233	N/A	08/01/2013
PORTUGAL	Oporto <del>XX</del>	01/01	12/31	155	64	219	N/A	08/01/2013
PORTUGAL	Other <del>*</del>	01/01	12/31	114	76	190	N/A	08/01/2013
PORTUGAL	Ponta Delgada	04/01	10/31	209	70	279	N/A	08/01/2013
PORTUGAL	Ponta Delgada	11/01	03/31	164	66	230	N/A	08/01/2013
PORTUGAL	Sao Miguel Island	04/01	10/31	209	70	279	N/A	08/01/2013
PORTUGAL	Sao Miguel Island	11/01	03/31	164	66	230	N/A	08/01/2013

\* Other: BRAGA, PORTUGAL

\*\* PORTO IS THE NEAREST LARGE CITY

















**Foreign Per Diem Rates In U.S. Dollars**

**Country: GERMANY**  
**Publication Date: 09/01/2013**

Country Name	Post Name	Season Begin	Season End	Maximum Lodging Rate	M & IE Rate	Maximum Per Diem Rate	Footnote	Effective Date
GERMANY	Berlin	01/01	12/31	244	117	361	N/A	11/01/2012
GERMANY	Boeblingen	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Bonames	01/01	12/31	257	142	399	N/A	08/01/2013
GERMANY	Bonn	01/01	12/31	184	106	290	N/A	11/01/2012
GERMANY	Bremen	01/01	12/31	212	107	319	N/A	11/01/2012
GERMANY	Cologne	01/01	12/31	253	109	362	N/A	11/01/2012
GERMANY	Dresden	01/01	12/31	220	119	339	N/A	11/01/2012
GERMANY	Duesseldorf	01/01	12/31	227	95	322	N/A	11/01/2012
GERMANY	Echterdingen	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Erfurt	01/01	12/31	212	127	339	N/A	11/01/2012
GERMANY	Eschborn	01/01	12/31	257	142	399	N/A	08/01/2013
GERMANY	Esslingen	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Frankfurt am Main	01/01	12/31	257	142	399	N/A	08/01/2013
GERMANY	Garmisch-Partenkirchen	01/01	12/31	131	87	218	N/A	08/01/2013
GERMANY	Hamburg	01/01	12/31	225	121	346	N/A	11/01/2012
GERMANY	Hannover	01/01	12/31	185	110	295	N/A	11/01/2012
GERMANY	Heidelberg	01/01	12/31	212	127	339	N/A	11/01/2012
GERMANY	Herongen	01/01	12/31	227	95	322	N/A	11/01/2012
GERMANY	Hoechst	01/01	12/31	257	142	399	N/A	08/01/2013
GERMANY	Kalkar	01/01	12/31	227	95	322	N/A	11/01/2012
GERMANY	Koenigswinter	01/01	12/31	184	106	290	N/A	11/01/2012
GERMANY	Kornwestheim	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Leipzig	01/01	12/31	200	94	294	N/A	11/01/2012
GERMANY	Ludwigsburg	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Mainz	01/01	12/31	227	104	331	N/A	11/01/2012
GERMANY	Moenchen-Gladbach	01/01	12/31	227	95	322	N/A	11/01/2012
GERMANY	Munich	01/01	12/31	253	138	391	N/A	11/01/2012
GERMANY	Nellingen	01/01	12/31	227	113	340	N/A	11/01/2012
GERMANY	Oberammergau	01/01	12/31	131	87	218	N/A	08/01/2013
GERMANY	Offenbach	01/01	12/31	257	142	399	N/A	08/01/2013
GERMANY	Other	01/01	12/31	212	127	339	N/A	11/01/2012
GERMANY	Roedelheim	01/01	12/31	257	142	399	N/A	08/01/2013

**Air Availability/Fare Quote**
















La Crosse, WI To Porto, Portugal Mon, Mar 10 - Mon, Apr 7

Price	Carrier	Depart	Arrive	Stops	Duration
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 06:30 pm	2	37h 45m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 09:15 pm	2	40h 30m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 09:40 am	2	52h 55m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 06:30 pm	2	37h 45m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 09:15 pm	2	40h 30m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 06:25 am	→ OPO 03:15 pm	2	27h 50m
		OPO 10:45 am	→ LSE 09:40 am	2	52h 55m
Compare		) (	+	More like this Show details	
\$960.90	 American  TAP Portugal	LSE 10:10 am	→ OPO 03:15 pm	2	24h 5m
		OPO 10:45 am	→ LSE 06:30 pm	2	37h 45m



### Air Availability/Fare Quote

Porto, Portugal To Frankfurt, Germany Thu, Feb 20 - Thu, Feb 27

Price	Carrier	Depart	Arrive	Stops	Duration
\$182.80 €137.80	 Lufthansa	OPO	FRA	0	2h 55m
		06:15 am	→ 10:10 am		
Compare	More like this +			Show details 	
	\$182.80 €137.80	 Lufthansa	OPO	FRA	0
12:25 pm			→ 04:15 pm		
Compare	More like this +			Show details 	
	\$199.10 €150.09	 TAP Portugal	OPO	FRA	1
06:55 am			→ 06:25 pm		
Compare	More like this +			Show details 	
	\$199.10 €150.09	 TAP Portugal	OPO	FRA	1
06:55 am			→ 10:30 pm		
Compare	More like this +			Show details 	
	\$199.10 €150.09	 TAP Portugal	OPO	FRA	1
11:10 am			→ 10:30 pm		
Compare	More like this +			Show details 	
	\$257.10 €195.21	 TAP Portugal	OPO	FRA	0
06:15 am			→ 10:10 am		
Compare	More like this +			Show details 	
	\$257.10 €195.21	 TAP Portugal	OPO	FRA	0
12:25 pm			→ 04:15 pm		
Compare	More like this +			Show details 	
	\$273.70 €207.81	 TAP Portugal	OPO	FRA	1
06:55 am			→ 06:25 pm		