PolyRMC celebrates its first anniversary,

August 22, 2008

Mission statement:
To be the world’s premier center for polymerization reaction monitoring R&D

Motto:
Value and impact based on scientific and technical excellence, integrity, and relevance

PolyRMC was founded after Hurricane Katrina devastated New Orleans. We are proud to be part of the rebirth and rebuilding of Tulane and New Orleans.

Highlights:
A New Orleans Innovator of the year Award. Strong flow of advances, publications, and presentations. Louisiana Initiatives with local industries launched March, 2008: First plenary meeting of the PolyRMC Advisory Board
PolyRMC nears its first anniversary with a diverse cast of participants and range of efforts and activities. The Advisory Board was hand-crafted this year and is composed of an unusual group of distinguished members of far flung academic, industrial, and business expertise. The March 2008 meeting set into motion a flurry of initiatives and missions, and demonstrated the strong support and vote of confidence PolyRMC has from the Tulane Administration.

Research efforts concentrated on breaking ground in monitoring and characterization of emulsion polymerization and ‘living’ type reactions, predictive control of reactions and processes, and exploring fundamental properties of polyelectrolytes. Numerous publications and presentations flowed from PolyRMC this year, and more novel instrumentation was brought online. A strong component of Louisiana Initiatives - building relationships with the vast local industry- was launched, along with the development of a business plan for a potential New Orleans based spin-off enterprise. Research collaborations spanned the globe, including a new natural products effort beginning with Brazil and Uzbekistan, and strong industrial collaborations continuing in North America and Europe. Support from NSF, the Louisiana Board of Regents, NASA via TIMES, and several of our private sector sponsors continued. We especially acknowledge Arkema Inc., Brookhaven Instruments Corp., Total S.A., and Polymer Laboratories Ltd. (now part of Varian, Inc.).

PolyRMC members, colleagues and supporters look forward to a very intense upcoming year, complete with inevitable growing pains, and unbounded enthusiasm.

Alina M. Alb, Associate Director for Research
Michael F. Drenski, Associate Director for Instrumentation
Wayne F. Reed, Founding Director
Postdoctoral Associates
Dr. Daniel Elizarrarás
Dr. Rilton Alves de Freitas

- Graduate Students
  Tomasz Kreft
  Colin McFaul
  Zheng Li
  Pascal Enohnyaket (Ph.D. 2007)

- Undergraduate Students
  Alex Reed
  Megan Sullivan
  Gerard Lakin

Prof. Wayne Reed

Prof. Alina Alb – ACOMP exp.

Tomasz Kreft – ACOMP exp.

Michael Drenski and Colin McFaul– SMSLS exp.
Recent Personnel and Visitors


Academic Collaborators


Collaborators coming soon to PolyRMC:
Dr. F. Bentrem, NRL; Dr. N. Normakhamatov, Uzbekistan; Prof. F. H. Florenzano, Brazil
A major advance in ACOMP capabilities has been the development of a ‘dual detection stream’ that permits simultaneous characterization of both the colloids (e.g. monomer droplets and latex particles) and the polymer/monomer components involved in emulsion-based polymerization reactions.


Our Arkema colleagues provided expertise in redox coupled initiation in emulsion polymerization and joined in the following ACS presentation:


ACOMP was applied for the first time to monitoring RAFT (reversible addition fragmentation chain transfer) reactions, and was used to follow the transition between controlled and uncontrolled free radical polymerization. ACOMP has now been adapted to the major types of controlled radical polymerization: NMP, ATRP, and RAFT. Our Australian colleague on this was Dr. Algirdas Serelis from Dulux Australia.

• First series of gradient and diblock copolymers by RAFT were monitored by ACOMP


• An unusual but practical mathematical formalism was developed to solve the classically difficult problem of determining absolute copolymer molecular weight. The formalism was immediately adapted to ACOMP and experimentally tested:


\[
M_w(f) = \frac{1}{f} \int \frac{f M_w(f) \left( \sum y_j f^j w_j \right)^2}{\left( \sum y_j f^j w_j \right)^2} df
\]

• The complex kinetic events involved in copolymeric polyelectrolyte synthesis were monitored for the first time. In this case, an unexpected blend of copolyelectrolytes and homopolymers resulted under certain reaction conditions.

• As a sequel to the first monitoring of copolyelectrolyte synthesis, deployment of a robust conductivity probe within the ACOMP platform has yielded, for the first time, quantitative measurements of counterion condensation during synthesis. This paves the way towards a wide variety of possible fundamental studies on polyelectrolyte properties as they develop during synthesis.


• Monitoring changes in polymer characteristics while they are being modified by post-polymerization reactions, which is an important alternate route to functional polymers, is an area of strong PolyRMC interest. In this first study, the changes in polymer scattering, viscosity, and conductivity were monitored as polyacrylamide was base-hydrolyzed into a polyelectrolyte.


• The first predictive control of molecular weight in free radical homopolymers reactions was achieved.

• It was found that polybutadiene chain scission and crosslinking in solution by free radical initiators occurs. The scission kinetics were quantified using ACOMP. Our Total S. A. colleagues on this were Drs. Scott Cooper and José Sosa.


• PolyRMC staff were invited to write a review article about ACOMP’s ten year old history of accomplishments in the polymerization monitoring field.

A. M. Alb, M. F. Drenski, W. F. Reed, “Automatic continuous online monitoring of polymerization reactions (ACOMP)”, Polymer International (invited) 2008, 57, 390-396

• Highlights of recent ACOMP advances, focusing on emulsion polymerization monitoring and RAFT were the subject of invited articles and presentations at congresses.

A. M. Alb, W. F. Reed, “Recent advances in ACOMP”, Macromolecular Symposia, in press


W. F. Reed, M. F. Drenski, A. M. Alb, “Recent advances in automatic continuous online monitoring of polymerization reactions (ACOMP)”. ISPAC, Univ. of Delaware, June 2008.

• In a continuation of the Tulane/U Mass collaboration that was fortuitously engendered by Hurricane Katrina, this collaboration with Maria Santore’s group brought our ACM (Automatic Continuous Mixing) methods to bear on Maria’s efforts in surface deposition of polymeric micelles.

An area of intense interest at PolyRMC is to develop online methods for quantifying processes involving natural products, such as extractions, enzymatic and chemical modifications, encapsulation of other agents, and the formation of nanostructures. These have wide applications in the pharmaceutical, food, agricultural, cosmetic, and materials industries.

The National Science Foundation (CBET 0623531) has provided funds to help spur this collaboration, aiding in travel and activities of PolyRMC in Brazil, while the Brazilian government and other organizations provide for Brazilian students and scientists to spend time at PolyRMC.

The PolyRMC Director gave a series of talks in Brazil to launch the new initiative:

**Métodos novos para a caracterização das soluções de polímeros**

Universidade Federal do Rio Grande do Sul, Porto Alegre, 11/5/07

Profs. N. Silveira, D. Samios

Universidade Federal de Sta. Catarina, Florianopolis, 11/6/07

Profs. E. Minatti, F. Nome, D. Zanetti

Universidade Federal de Paraná, Curitiba, 11/7/07

Profs. J. Silveira, M. R. Sierakowski, L. Akcelrud

Congresso Brasileiro/Argentino de Bionanotecnologia, Itajai, 11/9/07

Profs. R. Alves de Freitas, T. Bresolin

Other collaborating Brazilian faculty:


Prof. Rilton Alves de Freitas, sponsored by CNPq is spending a six month sabbatical at PolyRMC, investigating the derivitization of chitosan using reaction monitoring and other characterization methods.
Another line of investigation in Natural Products opens; US/Uzbekistan Collaboration. Through a grant by the U.S. Civilian Research & Development Foundation, PolyRMC has begun a collaboration with Prof. A. Boymirzaev and his colleagues of the Tashkent State Technical University.

Patents. Two new patent applications were filed this year; one provisional, one complete.

New Instrumentation. PolyRMC received the first commercial ACOMP unit from Polymer Laboratories Ltd., produced under license from Tulane, and is actively collaborating to optimize its performance and expand its capabilities. PolyRMC is also developing new monitoring and GPC instrumentation.

Update on Louisiana Initiatives

First links with Louisiana industry forged
Dan Borné disseminated word of PolyRMC’s Louisiana Initiatives to the Louisiana Chemical Association. That sparked four immediate respondents, with three meetings already concluded, and plans to move forward in each case on industrial problem solving and characterization issues.

Business plans
Under the guidance of the PolyRMC Advisory Board, and John Christie and Jake Maczuga from the Tulane Technology Transfer and Business Development Office, PolyRMC undergraduate Alex Reed has been working with interns Shreya Biswas and Justin Peno, as well as New Orleans BioInnovation Center Commercialization Coordinator Steven Ceulemans to develop a business plan for PolyRMC characterization and industrial problem solving services. The plan will help develop the efficiency, organization, and marketability of PolyRMC to enable it to reach out more effectively to businesses in the polymer and polymer pre-cursor manufacturing industry.
PolyRMC gratefully acknowledges funding from the following sources over the past year:

National Science Foundation CBET 0623531,  
*Dr. Maria Burka*, Program Manager

Louisiana Board of Regents

NASA via Tulane Institute for Macromolecular Engineering and Science (TIMES)  
*Prof. Daniel DeKee*, TIMES Director  
*Dr. Michael Meador*, NASA PI

Arkema, Inc.  
*Dr. Chris Roger*, Arkema Project Director

Total S.A.  
*Dr. Philippe Tanguy*  
Jean-Francois Minster

Polymer Laboratories (now a part of Varian, Inc.)  
*Dr. John McConville*  
*Dr. Steven O'Donahue*

PolyRMC also acknowledges other collaborations on instrumentation with:

- Brookhaven Instruments Corporation
- Shimadzu

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The Advisory Board was slowly hand-crafted during PolyRMC’s first year and is comprised of a distinguished group of members of astonishingly diverse backgrounds and expertise.

Mr. Dan Borné, President, Louisiana Chemical Association, (Baton Rouge, LA)

Dr. Bill Bottoms, Chairman and CEO of NanoNexus Inc. (San Jose, CA)

Mr. Ronald J. Evans, Owner, International Packaging Co., (New Orleans, LA)

Dr. Raymond S. Farinato, Research Fellow, Kemira Water Solutions, Inc. (Stamford, Ct).

Dr. John McConville, Polymer Laboratories Ltd. (Varian Inc.), Head of N. Am. Sales, Analytical, Global Business Dev., Process Monitoring and Control (Amherst, MA)

Dr. Chris Roger, Arkema, Inc., Director of Corporate and External Research (Philadelphia, PA)

Dr. Walther Tscharnuter, President, Brookhaven Instruments Corp. (Holtsville, NY)

Dr. Hyuk Yu, Walter H. Stockmayer Professor Emeritus & Eastman Kodak Professor Emeritus of Chemistry at the University of Wisconsin-Madison. (Madison, Wisconsin)

Dr. José Carlos Pinto, Professor Titular of the Chemical Engineering Program/COPPE at the Federal University of Rio de Janeiro, Brazil. (Rio De Janeiro, Brazil).

Most of the PolyRMC Advisory Board: Mr. Dan Borné, Mr. Ronald Evans, Prof. Hyuk Yu, Dr. William Bottoms, Prof. Alina Alb, Dr. Walther Tscharnuter, Prof. Wayne Reed, Dr. John McConville, Mr. Michael Drenski
International Collaborations and Participants

USA                  Romania             France        Mexico
Brazil                  Spain               Cameroon             Poland
China                 Turkey            Uzbekistan            Korea
Switzerland           Britain                Canada             Australia