IVth Sino-French Symposium on Polymers and Soft Matter


We greatly thank all the sponsors of the IVth French-Chinese Workshop on Polymers and Soft Matter
Dear Participant,

We are very happy to welcome you for this 4th edition of the Sino-French workshop on macromolecules and soft matter. This workshop was initiated in 2009 by the ESPCI and the University of Fudan. After three successful editions in Shanghai (May 2009), Paris (October 2010) and Hefei (May 2012), we decided to organize the workshop in Strasbourg. Located at the border between France and Germany, Strasbourg is famous for its single-tower cathedral, its old historical center and, of course, its wine and food culture!

However, Strasbourg is also one of the main historical spots for Chemistry and Physics in Europe. Having changed back and forth between France and Germany through History, Strasbourg has hosted famous scientists such as Hermann Staudinger, Pierre Weiss, Emil Fischer, Wilhelm Röntgen and Jean-Marie Lehn. In this exciting scientific context, we are happy to welcome this year 32 invited speakers from China and France. This year workshop will be a part of the “Institut Charles Sadron Conference Series”, a label created four years ago and given each year to a conference organized by members of the Institut Charles Sadron.

We hope that this exciting program will permit to establish strong ties and collaborations between France and China and wish you three days of excellent science in Strasbourg.

Michel Bouquey  Costantino Creton  Jean-François Lutz  Carlos Marques  Pierre Muller

Program

Monday October 12th morning
Chairman: Jean-François Lutz

8:30 Opening Ceremony. ICS and ESPCI-PSL welcome

9:00 TANG Benzhong (Hong Kong Univ. of Sci. and Tech.)
AIE-Active Macromolecules

9:25 CHARLEUX Bernadette (Saint Gobain)
Global R&D at Saint-Gobain and focus on the polymer activities in China

9:50 TANG Chuanbing (Univ. of South Carolina)
Metallocene Polyelectrolytes: from Chemoselective Synthesis to Biomedical Applications

10:15 Coffee Break

10:45 LI Min-Hui (Chimie ParisTech – PSL)
Towards biocompatible and biodegradable stimuli-responsive polymersomes

11:10 ZHOU Yongfeng (Shanghai Jiaotong Univ.)
Facile Functionalization of polymeric self-assemblies

11:35 CHASSENIEUX Christophe (Univ. of le Mans)
Amphiphilic Block Copolymers: Search for Tunable dynamics

12:00 WANG Feng (Univ. Sci. & Technol. China, Hefei)
Controlled Supramolecular Polymerization Based on the π-Conjugated Organometallic Building Blocks

12:25 Lunch Break
Monday October 12th afternoon

Chairman: Jacques Lalevée

13:30  **OBERDISSE Julian (Univ. of Montpellier)**  
Contrast-matching gone wrong? A study of chain conformation in polymer nanocomposites

13:55  **CHEN Hongzheng (Zhejiang Univ.)**  
Enhanced Efficiency of Polymer and Perovskite Solar Cells Via Interface Engineering

14:20  **TRIBET Christophe (ENS Paris – PSL)**  
Dynamic surface switches based on adlayers of stimuli-responsive poly(Lysine) comb-like copolymers

14:45 Coffee Break and poster session

15:45  **WOISEL Patrice (Univ. of Lille)**  
Supramolecular chemistry: a powerful tool to elaborate “colourful” multi-stimuli responsive macromolecular assemblies

16:10  **XU Huaping (Tsinghua Univ.)**  
ROS Responsive Selenium-containing Polymers

16:35  **THOMAS Christophe (Chimie ParisTech – PSL)**  
Polymerization of Heterocycles: a Simple Approach to Sequence Control in Polymer Synthesis

17:00  **LI Yuesheng (Tianjin Univ.)**  
Development of Facile and Efficient Strategy to Chemical Modified Isotactic Polypropylene with Well-defined Structure
Tuesday October 13th

Chairman: Carlos Marques

8:30  **LECOMMANDOUX Sébastien (Univ. of Bordeaux)**
Self-assembled polymersomes as virus and cell mimics

8:55  **LIU Shiyong (Univ. Sci. & Technol. China, Hefei)**
Hyperbranched Self-Immolative Polymers (hSIPs) for Programmed Payload Delivery and Ultrasensitive Detection

9:20  **DESTARAC Mathias (Univ. of Toulouse)**
Some new trends in aqueous RAFT/MADIX polymerization

9:45  **NICOLAY Renaud (ESPCI Paristech – PSL)**
Exploring old and new dynamic covalent chemistries for formulation and material science

10:10 **THALMANN Fabrice (Univ. of Strasbourg)**
Investigating lipid membrane dynamics at a nanoscale with excimer fluorescence: lessons from molecular dynamics simulations

10:35 Coffee Break

11:05 **LI Zichen (Peking Univ.)**
Importance of Monomer Sequence in Controlling the Properties of Polymers

11:30 **PONSINET Virginie (Univ. of Bordeaux)**
Polymer self-assembly: towards materials with novel optical properties

Self-polarized piezoelectric thin films: preparation, formation mechanism and application

12:20 **DUCHET Jannick (Univ. of Lyon)**
Ionic liquids: new additives for the polymer materials

Afternoon: Free afternoon
Wednesday October 14th

Chairman: Costantino Creton

8:30  **GRANDE Daniel (CNRS – Thiais)**
Crossing porosity scales in functional polymer materials: From design to application

8:55  **Zhu Jintao (Huazhong Univ. of Sci. and Tech.)**
Assembly of Block Copolymers in 3D Confined Geometry

9:20  **HEUX Laurent (Univ. of Grenoble)**
Man-made and bioinspired materials from nanocellulose: challenges and opportunities

9:45  **BOUQUEY Michel (Univ. of Strasbourg)**
Using intensified polymerization processes to elaborate novel polymeric materials

10:10 **SANSON Nicolas (ESPCI ParisTech – PSL)**
Cold Welding or How Polymer/Surfactant Interactions Promote the Welding of Colloidal Gold Nanoparticles

10:35 Coffee Break

11:05 **WANG Changchun (Fudan Univ.)**
Stimuli-responsive biodegradable polymer nanoparticles for triggered drug delivery system

11:30 **BASCHNAGEL Joerg (Univ. of Strasbourg)**
Modeling of solvent evaporation from thin glass-forming polymer films: Molecular-dynamics simulations and diffusion equation approach

11:55 **WU Zongquan (Hefei Univ. of Tech.)**
Facile Synthesis of Stereoregular Helical Polyisocyanide and Its Copolymers

12:20 Closing Ceremony
1982: BS, Department of Polymer Science & Engineering, South China University of Technology
1988: PhD, Department of Polymer Chemistry, Kyoto University, Kyoto, Japan
1989-1994: Postdoctoral Research Associate, University of Toronto, Toronto, Ontario, Canada
1994: Assistant Professor, Department of Chemistry, HKUST
2008: Chair Professor, Department of Chemistry, Division of Biomedical Engineering, Division of Life Science, HKUST

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**Current Research interests:**
- Exploration of new polymerization reactions
- Synthesis of new functional (macro)molecules
- Deciphering of new luminescent processes
- Creation of new advanced materials
- Development of new fluorescent biosensors

**Selected Recent Publications**
AIE-Active Macromolecules

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Abstract: Polymers with aggregation-induced emission (AIE) are widely studied recently because of their good solubility, processability, and high emission efficiency in the aggregated states. A large variety of AIE-active macromolecules have been developed. In this talk, the research efforts directed to AIE-active macromolecules including the designs and syntheses, structures and topologies, as well as functionalities and applications will be introduced with an emphasis on the most up to date progress. The synthetic approaches for the construction of AIE macromolecules include chain polymerizations such as free-radical polymerization and metathesis polymerizations, step polymerizations such as transition-metal catalyzed carbon-carbon coupling reactions and polycycloadditions, as well as post-modification of polymers. Through such versatile polymerization approaches, a vast array of AIE macromolecules with various chemical and topological structures can be easily accessed such as linear or zigzag shaped oligomers and polymers, star-shaped oligomers, dendrimers and hyperbranched polymers, conjugated microporous polymers, as well as crystalline supramolecular polymers. Combining the AIE characteristics with the desired traits of the polymeric materials will endow the resulting macromolecules with fascinating functionalities and they have found applications in fluorescent sensors, stimuli-responsive materials, biological probes, cell imaging, electroluminescence devices, optical nonlinearities, circular polarized luminescence, photopatterning, light refractive materials, liquid crystalline, gas adsorption, etc. AIE-active macromolecule is still a young research area with numerous possibilities and it is a fast-growing promising field.[1],[2]

Key Words: aggregation-induced emission, macromolecules

Reference:
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1991: Ph.D. University Claude Bernard Lyon 1
1993: CNRS researcher, Laboratory of Macromolecular Chemistry, University Pierre & Marie Curie, Paris 6
2001: Professor at the University Pierre & Marie Curie, Paris 6
2009: Professor at the University Claude Bernard, Lyon 1; senior member of the Institut Universitaire de France; director of the Laboratory of Chemistry, Catalysis, Polymers & Processes
2013: Deputy Director for R&D at Saint-Gobain

Past Research Area

The former research activity developed in academic laboratories was devoted to polymer chemistry with a focus on kinetic and mechanistic studies of ionic polymerizations and conventional and controlled radical polymerizations. A special attention was given to reactions in aqueous and non-aqueous dispersed media, with the synthesis of well-defined polymer architectures, their self-assemblies (in particular the development of polymerization-induced self-assembly) and the synthesis of organic-inorganic hybrid nanostructured colloids.

Selected Recent Publications

Core-Shell Nanoreactors for Efficient Aqueous Biphasic Catalysis

Synthesis of Amphiphilic Poly(acrylic acid)-b-poly(n-butyl acrylate-co-acrylic acid) Block Copolymers with Various Microstructures via RAFT Polymerization in Water/Ethanol Heterogeneous Media

Dynamic behavior of crosslinked amphiphilic block copolymer nanofibers dispersed in liquid poly(ethylene oxide) below and above their glass transition temperature

Polymerization-induced self-assembly: From soluble macromolecules to block copolymer nano-objects in one step

Toward a better understanding of the parameters that lead to the formation of non-spherical polystyrene particles via RAFT-mediated one-pot aqueous emulsion polymerization.
Abstract

Research and Development at Saint-Gobain: Global overview and Research in China in the domain of Performance Plastics

Yiwei Fu,¹ Jing Dai,¹ Yue Dong,¹ Eric Yin,¹ Muthu Jeevanantham,¹ Bernadette Charleux²*

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The Research and Development organization and strategy of Saint-Gobain at the global level will first be presented: R&D centers, open-innovation, university collaborations and transversal programs. A special attention will then be given to the R&D activities in China with a highlight on the Performance Plastics business and the foams & tapes products. A particular example regarding the development of a new foamed bonding tape will be given, as a technical illustration.
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Dr. Chuanbing Tang received B.S. from Nanjing University and Ph.D. from Carnegie Mellon University with Profs. Krzysztof Matyjaszewski and Tomasz Kowalewski. He was a postdoctoral scholar at the University of California Santa Barbara with Profs. Edward J. Kramer and Craig J. Hawker. Since August 2009, he has been an Assistant, Associate and College of Arts and Sciences Distinguished Professor in Department of Chemistry and Biochemistry at the University of South Carolina. His research interests focus on organic polymer synthesis, sustainable polymers from renewable natural resources, metal-containing polymers, and polymers for biomedical application and nanophase-separated copolymers for energy storage. He has been recognized with a few awards including NSF Career Award, Thieme Chemistry Journal Award and USC Distinguished Undergraduate Research Mentor Award. He has also been named an ACS PMSE Young Investigator and a Rising Star at the University of South Carolina. He has published about 90 papers and 10 patent applications.

Selected Recent Publications

Metallopolymers combine synthetic efficiency and versatility of an organic polymer framework with unique properties of inorganic metals. Cationic metallocene-containing polymers have recently garnered attention with their emerging electrolyte chemistry and niche applications in biomedical fields. Advances in polymerization techniques have provided opportunities to prepare polymers with tunable chemistry and compositions, controlled topologies, predetermined molecular weight and narrow molecular weight distribution. In this presentation, I will talk about the latest development from chemoselective synthesis of cationic metallocene derivatives to the use of controlled and living polymerization for the preparation of well-defined polyelectrolytes. These cationic polyelectrolytes have shown surprising promise as novel antimicrobial agents that could kill some of most malicious bacteria. I will also discuss a new strategy to addressing bacteria resistance via revitalizing conventional β-lactam antibiotics.

References:

Degrees:
1986 Bachelor of Engineering, Tsinghua University, Beijing, China
1988 Master of Polymer Science, Tsinghua University, Beijing, China
1993 Ph. D., Pierre & Marie Curie University, working in the Laboratoire Léon Brillouin in CEA
2005 Habilitation (HDR 博导证书)

Research:
1993-1994 Post-doc, French Institute of Petroleum (IFP)
1994-1997 CNRS Research Scientist (Assistant Professor), Paul Pascal Research Center (CRPP), Bordeaux
1997-2011 CNRS Senior Research Scientist (Associate Professor), Institut Curie, Paris
2011-2014 CNRS Research Director (Professor), Institut Curie, Paris
2014- CNRS Research Director (Professor), Chimie ParisTech, Paris

Current Research Area
- Polymersomes
- Soft actuators by liquid crystal polymers
- Polymer self-assembly
- Nanotechnology for drug delivery and bioimaging

Selected Publications

Towards biocompatible and biodegradable stimuli-responsive polymersomes

Min-Hui Li

Institut de Recherche de Chimie Paris, CNRS UMR8247, Chimie ParisTech, Paris, France

Synthetic amphiphilic polymers have been largely developed since last decades for the purpose of forming self-assembled polymer vesicles (polymersomes) which mimic lipid vesicles (liposomes). Polymersomes are much more stable, more robust and less permeable than liposomes due to the high molecular weight of polymers. Another interesting feature of polymersomes is that their properties can be tuned extensively by chemical design of the amphiphilic building blocks. These nanostructures are currently studied as a means of drug delivery and biomedical imaging for their ability to entrap hydrophobic molecules in the membrane and encapsulate hydrophilic ones in the inner aqueous compartment. The tailor-design of smart polymersomes, i.e., polymersomes bearing a protective coat, site-specific targeting ligands and stimuli-responsive release function, is state-of-the-art research in this field. The research of our group has focussed, since several years, on the development of stealth and stimuli-responsive polymersomes made from amphiphilic block copolymers. We develop robust and responsive nanostructures by combining the properties of two kinds of soft materials, polymers and liquid crystals (LC). In this talk I will describe our recent effort on developing biocompatible and biodegradable stimuli-responsive polymersomes.

My talk consists of two parts. In the first part I will describe a reduction-sensitive polymersomes, which can release encapsulated molecules under the action of glutathione, an intracellular trigger. In the second part, I will discuss polysarcosine-containing block copolymers and their thermo-responsive self-assemblies, especially polymersomes.

References:


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Current Research Area

- Supramolecular self-assembly of hyperbranched polymers and hybrid nanomaterials
- Cytomimetic chemistry by using the polymer vesicles as the model membranes
- Controllable synthesis of functional block copolymers with various topologies

Selected Recent Publications


Awards and Honors

- 2012, The Winner of the China National Funds for Distinguished Young Scholar
- 2009, The State Natural Science Award (the second prize)
- 2008, The National Excellent Doctoral Dissertation of China
Facile Functionalization of polymeric self-assemblies

Yongfeng Zhou*, Deyue Yan

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Hyperbranched polymers (HBPs), comprising of dendritic units, linear units and terminal units, are highly branched macromolecules with three-dimensional dendritic globular architecture. In recent years, we have synthesized many amphiphilic HBPs in a covalent or noncovalent way, and found these polymers can be used as the excellent precursors in solution self-assembly, interfacial self-assembly, or hybrid self-assembly self-assembly, and many impressive supramolecular aggregates at all scales and dimensions, such as macroscopic tubes, micro- or nano-vesicles, fibers, spherical micelles, honeycomb films, large compound vesicles and physical gels, have been obtained.

In this presentation, selected examples on the self-assembly and functionalization of hyperbranched polymer vesicles will be introduced. Although, it was firstly invented in year 2004 and was denoted as “branched-polymersome” (BP), there have been many kinds of HBP vesicles reported up to now, for example, pH-responsive BPs, peptide-coated BPs, protein-coated BPs, DNA-conjugated BPs, nanoparticle-coated BPs. In addition, some recent work in our lab on the functional nanotubes and micelles as well as the applications will be also discussed.

References

1994 : Polymer Science Master Degree Université du Maine, Le Mans, France
1997 : Ph. D. Université du Maine, Le Mans, France
1998: Research Fellow, University of Toronto, Canada within Pr. M. Winnik’ group
1998-2005: Assistant Professor, Laboratory of Physical Chemistry of Polymers, Paris, Université Pierre et Maris Curie, Paris France
2005- : Professor, Institut des Molécules et des Matériaux, Université du maine, Le mans, France

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Current Research Area
Self-assembly in solution and stimuli-responsive systems are research domains of prior importance for me and my main goal is to elaboration of functional nanostructured macromolecular assemblies. The fine control of their formation allows the development of several properties (rheological, transport,…) for various application fields (EOR, medicine, home and personal care,…). Since a clear image of these systems must be gained at several levels, I investigate them through a multiscale approach. Nevertheless, the first step for each study consists in synthesizing in large amount macromolecules with a perfect control of their structures, composition and molar mass distributions. Most of the time, controlled radical polymerization techniques and grafting reactions are processed. Recently, I have developed amphiphilic block copolymers whose dynamics of self assembly can be finely controlled through external triggers such as pH. I also use biomacromolecules (such as proteins and polysaccharides) in order generating nanostructured matrices for food industry.

Selected Recent Publications
Amphiphilic Block Copolymers: Search for Tunable dynamics.

A. Shedge, C. Charbonneau, O. Colombani, T. Nicolai, C. Chassenieux

LUNAM Université, Université du Maine, IMMM UMR CNRS 6283, Dept PCI, Avenue O. Messiaen, 72085 Le Mans cedex 05, France

Amphiphilic block copolymers are macromolecules composed of at least one hydrophilic block chemically linked to one or several hydrophobic blocks. In water, these macromolecules self-assemble to form micelles composed of a hydrophobic core surrounded by a hydrated hydrophilic corona. The majority of amphiphilic block copolymers form “frozen” micelles in aqueous solution. This means that there is no dynamic exchange of chains between micelles because the energy necessary to extract a hydrophobic block from the core of micelles is too high. Consequently, the characteristics of the micelles are controlled kinetically and not thermodynamically. In order to decrease this energy, we have incorporated acrylic acid units (AA) in the hydrophobic block of poly(n-butyl acrylate) (PnBA). It was previously shown that the incorporation of 50% molar of AA units in the hydrophobic block led to generation of pH-sensitive micelles in the case of PAA-b-P(AA0.5-stat-nBA0.5) diblocks.

We will present a quantitative analysis of the dynamics of self-assembled amphiphilic diblock and triblock copolymer based on acrylic acid units and n-butyl acrylate units. The hydrophobic blocks contained 50% of acrylic acids units incorporated randomly. The block copolymers were synthesized by controlled radical polymerization (ATRP). The influence of the concentration, pH, temperature and the ionic strength on the structure and the mechanical properties of the resulting self-assembled hydrogels was systematically studied. At low concentrations, static light scattering measurements showed the formation of star-like micelles (diblock) or flower-like micelles (triblock) above a critical aggregation concentration (CAC). At higher concentrations, purely repulsive excluded volume interactions between micelles appeared in the case of diblock copolymers. In the case of triblock copolymers bridging of flower-like micelles induced in addition attractive interactions leading to network formation above the percolation concentration. At high ionic strength and low pH, we showed that the attraction between flower-like micelles became sufficiently strong to induce phase separation. The formation of the network and the exchange dynamic of chains were studied by rheology. The viscosity of solutions increased sharply at the percolation concentration. The terminal visco-elastic relaxation time of the network is related to the lifetime of bridges. It could be controlled and tuned over several decades by varying of pH, temperature and the ionic strength.
2006: Master of Medicinal Chemistry from College of Pharmaceutical Sciences, Zhejiang University, Hangzhou, China.
2009: PhD of Supramolecular Chemistry from Department of Chemistry, Zhejiang University, Hangzhou, China.
2011-present: Associate Professor, CAS Key Laboratory of Soft Matter Chemistry University of Science and Technology of China, Hefei, China

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Current Research Area
My current research is focused on the fabrication and mechanism investigation of supramolecular π-conjugated polymers, which are driven by the combination of multiple non-covalent bonds such as donor-acceptor, hydrogen bonding and metal-metal interactions. The responsiveness of the resulting supramolecular polymers to external stimuli is also under investigation. The current study is expected to provide a range of potential applications such as smart/adaptive materials and supramolecular electronics.

Selected Recent Publications
Controlled Supramolecular Polymerization Based on the 
π-Conjugated Organometallic Building Blocks

Feng Wang

Department of Polymer Science and Engineering, CAS Key Laboratory of Soft Matter Chemistry, University of Science and Technology of China

Metallo-supramolecular polymers are considered as ideal candidates for the development of intelligent soft materials. Platinum(II) acetylide complex is an appealing metallo-building block due to its unique properties. Specifically, square planar geometry of the d8 transition metal ion, Pt(II), facilitates the combination with other non-covalent bonds, which potentially imparts cooperativity to the resulting self-assembly systems. Moreover, platinum(II) acetylide chromophore, due to its intriguing optical property, demonstrates promising applications in electronics and photonics fields. Herein, we have demonstrated that rod-like platinum(II) acetylide complex could self-assemble into ordered one-dimensional supramolecular architectures in a cooperative manner. Detailed mechanistic studies illustrate that both intermolecular hydrogen bonding and π–π stacking exert significant effects on the supramolecular polymerization process.1,2

On the other hand, we have successfully constructed novel supramolecular polymers based on the bis-alkynylplatinum(II) terpyridine molecular tweezer/arene recognition motif, which expands the host–guest toolboxes and represents a more versatile strategy for the fabrication of supramolecular polymeric assemblies. Furthermore, stimuli-responsive properties were assigned to the resulting supramolecular polymers, by taking advantage of the unique tweezer/arene recognition behavior. With the employment of anthracene derivatives and cyano-functionalized dienophile as the stimuli-responsive auxiliaries, supramolecular polymerization/depolymerization process could be precisely regulated in a facile manner. Such protocol advances the concept of utilizing Diels–Alder chemistry to achieve stimuli-responsive materials in compartmentalized systems.3

References

1994: Physics degree at Ecole Normale Supérieure de Lyon (France).
1997-1999: CNRS Researcher (Assistant Professor) at Laboratoire Léon Brillouin, Saclay, France.
1999-2000: Post-doc at Università Federico II di Napoli (G. Marrucci), Italy.
Since 2003: Laboratoire Charles Coulomb, University of Montpellier.
Since 2010: CNRS research director (Professor) at Laboratoire Charles Coulomb, University of Montpellier.

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Current Research Area

The general topics of the soft matter group of Laboratoire Charles Coulomb (Montpellier) encompass many fundamental research areas of soft matter science: liquid crystals, physics of biological systems, polymers, colloids, and surfactants, as well as any composite system. We are particularly interested in correlating structure, dynamics, and rheological properties of polymer nanocomposites. Starting from original formulations of model or simplified industrial nanocomposite systems, we focus on the analysis of microstructure of filler and chains by small angle scattering (neutrons and x-rays), and quantitatively coupled structural models based on electron microscopy and scattering. Recently, we have also turned to investigations of dynamics mainly using dielectric spectroscopy.

Selected Recent Publications

Contrast-matching gone wrong? A study of chain conformation in polymer nanocomposites

Anne-Caroline Genix¹, Amélie Banc¹, Christelle Dupas¹, Ralf Schweins², Marie-Sousai Appavou³, Julian Oberdisse¹

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³JCNS, FZ Jülich, Outstation at MLZ, D-85747 Garching, Germany

The structure of polymer nanocomposites has important consequences on final properties, like for instance mechanical reinforcement. While the structure of the hard filler phase is usually characterized by electron microscopy and small-angle X-ray scattering, the chain conformation can only be measured by small-angle neutron scattering (SANS). Continuous efforts over the past 15 years have produced a body of sometimes contradictory, because system-dependent, results, see e.g. [1,2]. In virtually all studies, however, a mismatch ruining the polymer form factor at low-angles has been observed, in spite of careful contrast-matching.

In this study, the conformation of polymer chains in silica-latex-nanocomposites has been studied under zero-average contrast conditions using SANS. Samples have been prepared by drying colloidal suspensions of silica and polymer nanoparticles (NPs) for two different silica NPs (radius of 5 and 15 nm) and two chain molecular weights (17 and 100 kg/mol). By appropriate mixing of hydrogenated and deuterated polymer, chain scattering contrast is introduced, and in principle silica scattering suppressed. The silica structure consisting mostly of small fractal aggregates is characterized by transmission electron microscopy (TEM) and small angle X-ray scattering (SAXS) on the same samples. The measurement of the chain structure by SANS, however, is perturbed by unwanted silica contributions, as often reported in the literature. Here, the contribution of contrast-matched silica is evidenced as a function of system parameters, namely chain mass, silica size, and volume fraction, and a model rationalizing these contributions for the first time is proposed. Via a statistical model, a nanometer-thick polymer shell surrounding silica NPs is shown to create contrast, which is presumably maintained by the reduced mobility of polymer close to interfaces or attractive polymer-silica interactions. This shell is proven to be quantitatively important only for the smallest silica NPs. As a consequence, the pure polymer scattering can be isolated, and the polymer radius of gyration is found to be independent of filler content and NP size [3].

1988: Chemistry degree, Zhejiang University, China
1994: Ph. D. Zhejiang University, China
1994-1996: Assistant Professor at Zhejiang University, China
1996-1999: Associated Professor at Zhejiang University, China
1999- : Full Professor at Zhejiang University, China
1999: Visiting Scholar for 3 months at Hong Kong University of Science & Technology, Hong Kong, China
1999-2001: Visiting Scholar at Antwerpen University and Interuniversities MicroElectronic Center (IMEC), Belgium
2005: Visiting Professor for half year at Stanford University, USA

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Current Research Area

The focus of the research done in my group is the organic (organic/inorganic) optoelectronic materials for photovoltaics, photodetectors and biosensors applications. The objective is to develop advanced organic (organic/inorganic) optoelectronic materials by tailoring molecular structures and aggregations, to construct new optoelectronic devices, and to achieve a fundamental understanding of optical and electronic processes in organic semiconductors. We are particularly interested in organic solar cell applications.

Selected Recent Publications

Enhanced Efficiency of Polymer and Perovskite Solar Cells Via Interface Engineering

Hongzheng Chen

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Polymer and hybrid solar cells have been the subject of extensive study for energy issues due to their potential applicability in low-cost, lightweight, flexible, solution-process ability and/or transparent large-area devices. Although the efficiency of both polymer and small molecule solar cells has already been reached to 10% for single junction device, there is one important hindrance for further efficiency improvement. Organic semiconductors usually have much lower charge transport and shorter exciton diffusion length compared to their inorganic counterpart. The low mobility and the short exciton diffusion length strongly limit the thickness of the photoactive layers in devices, leading to insufficient light absorption in the active layer due to the narrower absorption of the organics. In this presentation, I will talk about the design and the fabrication of highly efficient polymer and hybrid solar cells by enhancing light absorption, improving charge carrier mobility, interface engineering and so on. As a result, polymer solar cells and perovskite hybrid solar cells with high efficiencies over 10% were fabricated.

3. Zuo, L; Chang, CY; Chueh, CC; Zhang, S; Li, H; Jen, AKY; Chen, H., Design of a Versatile Interconnecting Layer for Highly Efficient Series-Connected Polymer Tandem Solar Cells, Energy & Environmental Science 2015, 8, 1712-1718.
1989 : Master of Science in Electrochemistry, Univ. Paris 6, France
1993 : Ph. D. Univ. Paris 6 (UPMC)
1992-1993 : Research Fellow, ULB, Bruxelles Belgium
1993-2007: CNRS Researcher (Assistant Professor) at ESPCI, Laboratory of Physical Chemistry of Polymers, Paris
2007- 2010 : CNRS Research Director (Professor) at ESPCI
2010- : CNRS Research Director (Professor) at Ecole Normale Supérieure, Paris

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Current Research Area
The group of Biophysical Chemistry at ENS Paris is interested in manipulating and understanding biological systems in new ways using the knowledge of chemistry. We develop in particular (macro)molecules and methods enabling observation, and remote control of biological targets, including living cells. Current research projects involving polymers include optically controlled cell permeabilization, switchable polymer layers that display biological ligands, artificial chaperons and microcapsules for protein protection.

Selected Recent Publications
- Jing Sun, J. Ruchmann, A. Pallier, L. Jullien, M. Desmadril, and C. Tribet, Biomacromolecules (2012), 13(11), 3736-3746, Unfolding of Cytochrome c upon Interaction with Azobenzene-modified Copolymers
Dynamic surface switches based on robust adlayers of light-, or temperature-responsive poly(Lysine) comb-like copolymers.

Fabrice Dalier, Emmanuelle Marie, Christophe Tribet

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Polymer hydrogels and polymer-coated surfaces are ubiquitous substrates for cell culture. Passive, static substrates are however limited compared to natural matrices that can dynamically affect cell migration, proliferation or cell fate by spatial and temporal modulation of presentation / sequestration of guidance cues.

We design systems that switch on demand the macromolecule-cell membrane association in cell culture conditions. Two “toolboxes” will be described: (1) soluble azobenzene-containing polyamphiphiles that bind to lipid bilayers and to cells under blue light, phototriggering mild cytosolic penetration of peptides. (2) Comb-like poly(Lysine)-g-PEO and PLL-g-(PNIPAM-co-ligand) derivatives that adsorb spontaneously on many substrates, and form cell-repellant layers. These layers become activated (displaying ligands, and triggering specific binding) by external stimulations including temperature shifts, exposure to light, or copper-free click reaction with an adhesion peptide. In addition to cell responses (triggering cell adhesion and migration on surface micropatterns), the switch of surfaces properties was assessed by AFM and by observation of the capture of Streptavidin-conjugated particles. It is correlated with switching between collapsed and extended conformations of surface-attached polymer strands.

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Current Research Area
Research within our research group focuses upon the design, synthesis and characterisation of functional macromolecules and nanoparticles and their assemblies. Current themes includes multi-stimuli responsive micelles, hydrogels, surfaces and smart supramolecular sensors.

Selected Recent Publications
Supramolecular chemistry: a powerful tool to elaborate “colourful” multi-stimuli responsive macromolecular assemblies

P. Woisel, Pr ENSCL

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The development and application of multi-stimuli responsive materials is a burgeoning field of study in leading research groups in the USA, Asia and mainland Europe. There is no doubt that the creation of such high performance materials relies directly on our ability to manipulate these “smart” materials in a controllable, predictable and orchestrated fashion from nano- to macro-scale.

Complexes fabricated from the electron deficient cyclophane cyclobis(paraquat-p-phenylene) (CBPQT\textsuperscript{4+}) and electron rich guests have become one of the most important building blocks for the synthesis of coloured self-assembled architectures. Here, I will report the successful engineering of new multi-stimuli responsive macromolecular assemblies based on well-defined functionalized polymer building blocks incorporating both electro-deficient (CBPQT\textsuperscript{4+}) and electron-rich units (tetrathiafulvalene, naphthalene) moieties. The architectures of these materials have been constructed by specifically holding together complementary well-defined polymer building blocks (prepared by Controlled Radical Polymerisation) with specially designed host/guest motifs attached in specific locations on polymer backbones. The inherent reversibility of supramolecular architectures has allowed “on demand” modular and tunable modification of structures and properties of materials. More particularly, we have exploited the presence of coloured CBPQT\textsuperscript{4+} based interactions to create i) “smart” micelles and hydrogels and ii) (re)programmable supramolecular temperature and pH sensors with memory function. An important practical aspect of these new functional materials is that all relevant phenomena (self-assembly and disassembly processes, reading/reprogramming of temperature, memory function) have an associated visible readout, thereby affording convenient and quantifiable systems with applications spanning the physical and biological sciences.

References
2001: Bachelor, College of Chemistry, Jilin University, China
2006: PhD with X. Zhang, College of Chemistry, Jilin University, China
2004-2005: Exchange student, University of Leuven, Belgium
2006-2008: Post-doc with D. N. Reinhoudt and J. Huskens, University of Twente, the Netherlands
2008- 2014: Assistant and Associate professor, Department of Chemistry, Tsinghua University
2014 till now: Professor, Department of Chemistry, Tsinghua University

Current Research Area

Selenium-containing Polymers: Redox responsive polymers have attracted wide interest for their promising applications in controllable encapsulation and delivery in physiological environments, where the redox process is constantly and widely present. We are aiming at designing and synthesizing all kinds of selenium-containing polymers, including main chain and side chain block copolymers, dendrimers and hyperbranched polymers for controlled self-assembly and disassembly under various responsive stimuli, leading to new biomaterials for controlled drug delivery and gene therapy.

Selected Recent Publications

Selenium, an essential element for animals and humans, possesses unique chemical and biological properties. As reactive oxygen species (ROS) are natural by-products of oxygen metabolism that may cause chronic diseases such as cancer and heart disease to human beings, great effort has been put to synthesize numerous antioxidant compounds based on selenium-containing small molecules. However, literatures on selenium-containing polymers are rather scarce. Here we are going to highlight the most recent advances on selenium-containing polymers and their potential bio-applications as ROS-responsive drug delivery vehicles in physiological conditions. Take the linear polymer for example, diselenide-containing amphiphilic block copolymer micelles exhibited unique dual redox triggered disassembly behavior in response to a very dilute concentration of ROS or reductant. The diselenide bonds could also be cleaved by ROS generated by photosensitizer under light radiation. As gamma rays is one of the most widely used radiation in clinical application and that gamma radiation on water could also produce ROS, selenium-containing polymers were also used for the combination of chemotherapy and radiotherapy.

![Scheme 1 Selenium-containing Polymers](image)

**References**

1996 M.S. in Chemistry, University of Strasbourg (France)

2002 Ph.D. in Chemistry, University of Neuchâtel (Switzerland)

2003 Postdoctoral Research Associate, Cornell University (NY, USA)

2004 Postdoctoral Research Associate, University of Neuchâtel (Switzerland)

2004 Assistant Professor, University of Rennes 1 (France)

2008 Professor, Chimie ParisTech (France)

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Current Research Area

- Development of new methods for polymer synthesis, with an emphasis on catalytic transformations and the control of stereochemistry
- Development of new strategies for tandem catalysis
- Use of inorganic oxides as supports for metal-based catalysts

Selected Recent Publications


Polymerization of Heterocycles: a Simple Approach to Sequence Control in Polymer Synthesis

Carine Robert¹, Frédéric de Montigny¹, Pierre Haquette¹, Christophe M. Thomas¹

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Given the growing need for inexpensive biodegradable plastics for use in various applications, the development of synthetic methods for the polymerization of a wide range of monomers with control over the stereochemistry, molecular weight, and comonomer incorporation is of particular importance¹. In this context aliphatic polyesters have emerged as biodegradable materials with huge potential.

Recently we have synthesized new biodegradable poly(β-hydroxyalkanoate)s (PHAs) with controlled primary structures². By using highly efficient yttrium complexes as initiators, we were able to synthesize highly alternating copolymers by ring-opening polymerization of a mixture of enantiomerically-pure but different monomers (Fig. 1). This efficient catalytic system makes copolymers that would be very difficult to make through any other method. Also we have reported a new strategy to obtain biodegradable polyesters³. This was achieved by tandem catalysis, which confers great interest to this approach⁴. Commercially available complexes were used as efficient catalysts for cyclization of dicarboxylic acids followed by alternating copolymerization of the resulting anhydrides with epoxides (Fig. 1). Given an operationally simple method, this tandem catalysis is an attractive strategy for the production of new renewable materials.

Current Research Area

The focus of the research done in our group is the coordination polymerization of olefin catalyzed by well-defined transition metal complexes. Present research work includes syntheses and characterization of new transition metal catalysts, copolymerization of olefin with polar/functional monomer, selective (co)polymerization of polyene monomers. In addition, we is also engaged into various aspects of polymer syntheses including various living polymerization and branched/hyperbranched polymer syntheses.

Selected Recent Publications


Development of Facile and Efficient Strategy to Chemical Modified Isotactic Polypropylene with Well-defined Structure

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Catalyzed by (pyridylamido)hafnium, a series of halogen-functionalized isotactic polypropylenes (iPP) were synthesized via the stereospecific copolymerization of propylene with ω-halo-α-alkenes. The high molecular weight (MW) functional iPPs possessing abundant iodoalkene units and high isotacticity were easily obtained under mild conditions with excellent catalytic activity. Detailed in situ NMR analysis, DFT calculations and the copolymerization of propylene with a series of ω-halo-α-alkenes suggest that the ω-iodine group has very weak interaction with the active Hf center, and ω-halo-α-alkenes with long chain show a better possibility to be copolymerized with propylene. The thiol-halogen click chemistry between halogenated iPPs and thiols was systematically investigated, based on which, various polar groups including hydroxyl, ester, aryl, thiazolyl and amino have been successfully introduced into iPP in a quantitative way, by employing iodinated iPP as the highly reactive intermediate.

The regio-/stereo-selective coordination copolymerization of propylene with p-(3-butenyl) styrene (BSt) was also conducted by using the Hf catalyst that produces exclusively high MW iPPs with abundant ethenyl benzene (styrene) groups. Remarkably, the current Hf catalyst, which exhibits overwhelmingly favorable reactivity toward α-olefin over styrene moieties, effectively promoted the copolymerization of propylene with BSt under judiciously chosen reaction conditions, in which catalytic activity (1.35 kg polymer/mmol Hf·h), MW, styrene group content and tacticity reached a satisfying level simultaneously. Various side- and graft-functionalized iPPs were synthesized via the UV-light initiated thiol-ene click chemistry and iodine- catalyzed hydroalkylation as well as controllable radical polymerization of the resultant propylene/BSt copolymer with commercially available materials.

The authors are grateful for financial support by the National Natural Science Foundation of China (No. 21234006).

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1998: Assistant Professor at the Ecole Nationale Supérieure de Chimie et de Physique de Bordeaux (ENSCPB) and Laboratoire de Chimie des Polymères Organiques (LCPO-CNRS)
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Current Research Area

SL is currently leading the group “Polymer Self-Assembly and Life Sciences” at the LCPO. His research interests include polypeptide and polysaccharide based block copolymers self-assembly, biomimetic approaches toward design of synthetic viruses and cells as well as the design of polymersomes for drug-delivery and theranostic. He is especially worldwide recognized for the design of original polymeric nanoparticles, “bioactive by design” and stimuli responsive, able to load and release “on demand” molecular and macromolecular drugs (anti-cancer, peptide,…). He is deputy director of the LCPO and will become director in January 2016. He is also currently chairing the ESF Research Network Programme on “Precision Polymer materials” P2M and in the board of the French Society of Nanomedicine (SFNano). He is Associate Editor for Biomacromolecules (ACS) and in the Editorial Advisory Board of several international journals, including Bioconjugate Chemistry (ACS), Polymer Chemistry and Biomaterials Science (RSC).

Selected Recent Publications

**Biomimetic polymersomes for virus and cell mimicry**

Sebastien Lecommandoux

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Polymersomes are among the most attractive systems for drug delivery applications. We report here an overview on the self-assembly in water of amphiphilic block copolymers into polymersomes, and their applications in loading and controlled release of both hydrophilic and hydrophobic molecules and biomolecules. We pay special attention to polysaccharide and polypeptide-based block copolymer vesicles (1). These copolymers that mimic the structure and function of glycoproteins represent an example of the effectiveness of a biomimetic strategy in implementing materials design. In addition, magnetic polymersomes, including iron oxide $\text{Fe}_2\text{O}_3$ nanoparticles are currently investigated, together with their potential applications as contrast agent for imaging and as therapeutic nanoparticles using hyperthermia (2). *In vitro* and *in vivo* efficacy results on different cancer models will be presented. Finally our recent advances in using “biomimicry approaches” to design complex, compartmentalized materials will be proposed. Such a system constitutes a first step towards the challenge of structural cell mimicry and functionality (3).


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1993: BS, Department of Environmental Science, Wuhan University, China
2000-2002: Postdoc, School of Life Science, University of Sussex, England
2002-2003: Postdoc, Department of Chemical Engineering, University of Delaware, USA
2004--: Professor at Department of Polymer Science and Engineering, University of Science and Technology of China
2010--: Director, CAS Key Laboratory of Soft Matter Chemistry

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Current Research Area

Current research interests include the design and synthesis of functional polymeric materials, colloids, and stimuli-responsive polymeric assemblies with controlled properties for applications in imaging, sensing, diagnostics, and nanomedicines.

Selected Publications


Hyperbranched Self-Immolative Polymers (hSIPs) for Programmed Payload Delivery and Ultrasensitive Detection

Guhuan Liu and Shiyong Liu*

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Upon stimuli-triggered single cleavage of capping moieties at the focal point and chain terminal, self-immolative dendrimers (SIDs) and linear self-immolative polymers (l-SIPs) undergo spontaneous domino-like radial fragmentation and cascade head-to-tail depolymerization, respectively. The nature of response selectivity and signal amplification has rendered them an unique type of stimuli-responsive materials. However, SIDs involve tedious multistep synthesis, and steric congestion at the periphery dictates that the SID generation is limited to the third, with a maximum amplification factor of 8. Although the signal amplification capability of l-SIPs can be modulated by chain lengths, they typically possess less design modularity and poor water solubility, and those equipped with side chain release motifs are also synthetically challenging; accordingly, core functions of l-SIPs in aqueous media (e.g., amplified drug delivery and sensing) have been far less explored as compared to those of SIDs. Thus, further advancement in the field of self-immolative polymers (SIPs) requires novel design criteria and a paradigm shift. Herein, we report the facile fabrication of water-dispersible SIPs with a novel chain topology, hyperbranched self-immolative polymers (hSIPs), by utilizing one-pot AB\textsubscript{2} polycondensation methodology and sequential post-functionalization. The modular engineering of three categories of branching scaffolds, three types of stimuli-cleavable capping moieties at the focal point, and seven different types of peripheral functional groups and polymeric building blocks affords both structurally and functionally diverse hSIPs with chemically tunable amplified release features (up to 20 per hSIP molecule). Based on the hSIP platform, we demonstrate myriad functions including visible light-triggered intracellular release of peripheral conjugated drugs in a targeted and spatiotemporally controlled fashion, intracellular delivery and cytoplasmic reductive milieu-triggered plasmid DNA release via on/off multivalency switching, mitochondria-targeted fluorescent sensing of H\textsubscript{2}O\textsubscript{2} with a detection limit down to ~20 nM, and colorimetric H\textsubscript{2}O\textsubscript{2} assay via triggered dispersion of gold nanoparticle aggregates. To further demonstrate the potency and generality of hSIP platform, we further configure it into biosensor design for the ultrasensitive detection of pathologically relevant antigens (e.g. human carcinoembryonic antigen) by integrating with enzyme-mediated positive feedback cycle amplification and enzyme-linked immunosorbent assay (ELISA).
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1997 : Ph. D. Montpellier 2 University, France
1997-1998 : Research Fellow, Carnegie Mellon University, Pittsburgh, USA
1998-2007: Project Manager then Scientific Expert at Rhodia, Aubervilliers R&D Center, Paris, France
2007- : Professor of Chemistry, University Paul Sabatier Toulouse 3 University, Toulouse, France

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**Current Research Area**

The activities of the *Precision Polymers by Radical Processes* (P3R) team revolve around controlled radical polymerization using RAFT technology. We study the structure-reactivity relationships of new RAFT agents, and the synthesis and physical chemistry of RAFT polymers, using the green solvents water and supercritical carbon dioxide wherever possible. Our chief field of activity is the synthesis of functional polymers with complex architecture and microstructure (amphiphilic and double hydrophilic block, comb and gradient copolymers) which possess targeted interfacial properties such as adhesion, stabilization of emulsions, dispersion of inorganic nanoparticles and rheology modification.

**Selected Recent Publications**

Some new trends in aqueous RAFT/MADIX polymerization

Aymeric Guinaudeau¹, Emmanuelle Read¹, Laurie Despax¹, Olivier Coutelier¹, Simon Harrisson¹, Stéphane Mazières¹, James Wilson² and Mathias Destarac¹

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Nowadays, there is a substantial need for new water soluble polymers with original properties. Reversible-deactivation radical polymerization (RDRP) is one of the most convenient approaches for tailor-making various kinds of hydrophilic polymers with complex architectures. Among the RDRP options available, xanthate-mediated RAFT (also known as RAFT/MADIX) polymerization is a method of choice because of its high tolerance to water and ionic monomers. In contrast with most of other classes of RAFT agents, xanthisates allow the synthesis of block copolymers based on monomers of highly disparate reactivities (e.g. acrylamides and N-vinyl monomers). We recently reported the first example of RDRP of N-vinyl pyrrolidone (NVP) in water by means of a RAFT/MADIX redox-initiated process at room temperature in the presence of a O-ethyl xanthate (refs. 1-2). Consequently, several original P(NVP)-based double hydrophilic block copolymers were prepared in pure water (2). We also pushed back the limits of molar mass control in aqueous RAFT/MADIX polymerisation through a fast and quantitative gel polymerisation of a series of acrylamido monomers (3). Unprecedentedly high Mn up to 10⁶ gmol⁻¹ with low dispersities (Ð < 1.2) were achieved. The reasons for access to abnormally high kinetic chain length in the presence of a RAFT/MADIX agent are discussed. Access to ultra-high molar mass thermoresponsive block copolymers and their physicochemical properties in water is presented. These findings can open up avenues for fast precision polymer synthesis in environmentally friendly conditions, and above all in ranges of molar masses that were not attainable before.

References

2003 M.S. in Chemistry & Chemical Engineering, ESCOM, France
2003-2004 M.S. in Chemistry and Physico-Chemistry of Polymers, Pierre et Marie Curie University, Paris, France
2004-2008 Ph.D. on Polymer Chemistry, Polymer Chemistry Lab, Pierre et Marie Curie University, Paris, France
2005-2009 Ph.D. on Living Radical Polymerization, Matyjaszewski Lab, Carnegie Mellon, Pittsburgh, USA
2010 Postdoctoral Researcher in E.W. (Bert) Meijer’s Group at the Eindhoven University of Technology (TU/e), the Netherlands
2010- Assistant Professor at ESPCI-ParisTech, Soft Matter and Chemistry Lab, Paris, France

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Current Research Area
Our research focuses on the development of new methodologies to prepare multifunctional polymeric architectures as well as on the conception of materials and formulations relying on dynamic covalent chemistry.

Selected Publications

- Le Neindre, M.; Nicolaý, R., "One-pot deprotection and functionalization of polythiol copolymers via 6 different thiol-X reactions" Polym. Int. 2014, 63, 887
- Nicolaý, R.; Kwak, Y.; Matyjaszewski, K., “A Green Route to Well-Defined High-Molecular-Weight (Co)polymers Using ARGET ATRP with Alkyl Pseudohalides and Copper Catalysis” Angew. Chem., Int. Ed. 2010, 49, 541

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Vitrimer are a new class of permanently cross-linked networks that can undergo associative exchange reactions through dynamic covalent bonds. As a result, the topology of these networks can be dynamic under certain conditions, which allow these materials to relax stress or to be reshaped and recycled like thermoplastics, while being insoluble like thermosets [1-3]. Extending this concept to various exchange reactions and polymer matrices, as well as tuning the dynamics of the exchange reactions, to adapt to different processing routes, are examples of remaining challenges that are currently being addressed. In addition, some of the systems explored can be advantageously used in solvent formulations, to control their rheological properties for example.

1998 : Ph. D., University J. Fourier, Grenoble, France
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2001-2004: Assistant Professor University of Strasbourg, Laboratory of Complex Fluids Dynamics, Strasbourg France
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Current Research Area

My interest is in statistical and soft matter physics. I currently belong to the M3 (Membrane and Microforces) team in Institut Charles Sadron, which gathers several researchers and postgraduate students on both theoretical and experimental aspects of model lipid bilayers physics. One of our main current focus lies on the oxidative alteration of membranes, including their phase coexistences and permeation properties. The other focus is on the interaction and translocation of nanoparticles of size commensurate to the bilayer thickness. Finally, I am interested in lipid membrane dynamics and work on some aspects of colloidal physics such as the drying of waterborne latex suspensions.

Selected Recent Publications
Excimer formation of pyrene conjugated phospholipid molecules is sensitive to self-diffusion dynamics in lipid bilayers. Measures of the diffusion coefficient $D$ based on this phenomenon have been proposed as early as 1974 (Galla, Sackmann). Using coarse-grained lipids (Martini) molecular dynamics simulation, we revisit these results and attempt to improve the determination of the diffusion coefficient $D$. This method opens a window on lipid molecular motions at the nanometer scale.
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1990: M.Sc. Institute of Chemistry, Chinese Academy of Sciences (CAS), China
1993-1994: Exchanging doctor course student, Waseda Univ. Japan
1997-: College of Chemistry, PKU.

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Current Research Area

The research interest of our group is polymer chemistry. In particular, we focused on developing new polymerization methods, controlling over the composition, sequence, topology as well as functional groups of polymers, with an aim to obtain polymers with precise structure and advanced properties like biomacromolecules. Most recently, we are interested in developing new polymerization methods based on multicomponent reactions for functional polymer synthesis, such polymerization methods are atom-economic, functional group tolerance and can be conducted under ambient reaction conditions, and therefore, may find many applications in constructing more complex polymer architectures and functions.

Selected Recent Publications

Importance of Monomer Sequence in Controlling the Properties of Polymers

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Microstructure control in polymer chain including sequence regulation has attracted much attention and is definitely a significant parameter in polymer design that leads to polymers with complex structures and sophisticated functions. Many types of polymers with controlled microstructure have been designed and synthesized in recent years. Then, the next question is how these microstructure variations can affect the polymer properties. In this talk, I will present some examples to show you the importance of specific monomer sequence in controlling the properties of polymers. It contains: (1) Three types of periodic vinyl copolymers were synthesized and the relationship between the monomer sequences and the thermal properties of these copolymers was elucidated. (2) The tandem reaction between the adjacent monomer units within a single polymer chain was realized upon post-modification of the internal alkenes of periodic vinyl copolymers. Those formed cyclic structure by the tandem reaction could increase the rigidity of the polymer chain and thus greatly increase the $T_g$ of the final polymer. (3) Passerini multicomponent polymerization was developed as a new method to synthesize functional poly(4-hydroxybutyrate)s. These polyesters exhibited unique degradation behavior in solution. The degradation was driven by the consecutive intramolecular cyclization to form stable a neutral $\gamma$-butyrolactone compound.
1994 : Ph. D. Paris 6, Collège de France
1994-1995 : Post-doc Fellow, Technion, Haifa, Israel
1995-1999 : CNRS Researcher (Assistant Professor) at the Collège de France, Condensed Matter Laboratory, Paris, France
1999-2004 : CNRS Researcher at the Rhodia-CNRS research center, Complex Fluids Laboratory, Cranbury, NJ, USA
2004-present : CNRS Researcher at the Centre de Recherche Paul Pascal, Bordeaux, France
2012-2013 : Visiting professor at the State Key Laboratory of Chemical Engineering, East China University of Science and Technology, Shanghai, China
Collab : Honglai Liu, Jun Hu, Xia Han

Current Research Area

- Hybrid materials composed of polymers and plasmonic nanoparticles; study of the relation between nanostructure and optical properties
- Ordered phases of block copolymers: application to nanoparticle structuration
- Self-assembled nanostructured and hybrid materials for metamaterial fabrication
- Structure and alignment of thin films of block copolymers
- Structure of complex fluids

Selected Recent Publications

1- Controlled Assembly of Plasmonic Nanoparticles Using Neutral-Charged Diblock Copolymers, Quanyi Yin, Xia Han, Virginie Ponsinet, Honglai Liu, J. Coll. Interf. Sci. 431, 97–104 (2014)
4- Facile formulation of high density well-ordered nanoparticle-copolymer nanocomposites, Benoit Maxit, Denis Bendejacq, Virginie Ponsinet, Soft Matter 8, 1317-1320 (2012)
Polymer-based nanomaterials with novel optical properties

Xuan Wang\textsuperscript{1}, Kevin Ehrhardt\textsuperscript{1}, Remy Robertson\textsuperscript{1}, Ashod Aradian\textsuperscript{1}, Philippe Barois\textsuperscript{1}, Virginie Ponsinet\textsuperscript{1}, Sergio Gomez-Graña\textsuperscript{2}, Mona Tréguer-Delapierre\textsuperscript{2}

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The interest for nanostructures has exploded in the recent years, with many applications in view, which has led to the search for new and versatile fabrication methodologies, among which nanochemistry and self-assembly have become promising routes. The versatility of chemical synthesis offers an almost unlimited range of achievable nanoparticles of controlled composition, size, shape, and surface coating. Self-assembly induces spontaneous structures, possibly presenting characteristic sizes at the nanoscale and variable degrees of order, using in particular liquid crystals, surfactants (or more generally amphiphiles) and block copolymers in the solid or dispersion states. Other types of controlled assembly phenomena, using polymer properties, can also be used to engineer complex colloidal assemblies, on which are based functional nanomaterials.

Among the exciting emerging functional nanomaterials, metamaterials are artificial composites presenting unusual properties of light propagation thanks to a specific structure at a lengthscale smaller than the operational wavelength. The search for meta-properties in the visible domain, which could open the way to technical breakthrough in optics such as hyperlenses and cloaking, is mostly focused on nanostructured plasmonic systems. In this context, chemistry and controlled assembly of metallic nanoparticles can lead to interesting dense organized structures, in which the localized surface plasmon resonances (LSPR) of the metallic nanoparticles at visible or near infrared wavelengths, provide large amplitude variations of the optical responses. Several experimental systems will be discussed here, with the goal of relating the controlled structures and the obtained unusual optical properties.
1994-1998: Sc.D. Nara Women’s University, Japan
1998-2000: JSPS Postdoctoral Fellowship, Japan
2000-2002: Research Associate, University of Washington, USA
2002-2009: Research Assistant Professor and Research Associate Professor, University of Washington
2009-present: Professor, University of Science and Technology of China

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Current Research Area

Her group research has focused on electroactive and conjugated polymers for sensor, artificial muscle and smart window applications (Boeing smart window and 3M project). She initiated her interest in smart materials and structures since 1998. Her team has focused on the design of soft/hard polymer network architectures ranging from conventional PVAs, PVDF materials all the way to soft swollen hydrogel electrode and flexible tactile sensor. They have particularly committed themselves into regulating solubility in aqueous/organic solvent for inkjet processable electrochromic applications and into tuning electron density of main chain for polymer film of different color and transmittance.

Selected Recent Publications
Self-polarized piezoelectric thin films: preparation, formation mechanism and application

Baozhang Li, Chengyi Xu, Feifei Zhang, Jianming Zheng, Chunye Xu*

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A facile method is introduced for preparation of porous self-polarized piezoelectric thin films (100–300 nm) by depositing polyvinylidene fluoride solution onto the surface of an aqueous solution. Polar β crystalline phase enhancement is realized with the addition of sodium chloride into the aqueous solution. Fully saturated piezoresponse hysteresis loops and out-of-plane piezoresponse phase images reveal that the PVDF films show good piezoelectricity and present a self-polarized feature with the C–F dipoles aligned vertically to the surface. Also, the film deposited on 15% salt aqueous solution shows the highest content of β crystalline phase. In addition, the device based on prepared multi-layer PVDF film is fabricated and characterized using homemade equipment. Notably, the device based on 50 layers of film deposited on the surface of a 15% salt aqueous solution shows the outstanding sensitivity of 52.2 pC N⁻¹ and electrical output of 24 V and 16 mA. It suggests that the facile method for preparation of self-polarized film has promising potential for assembling wearable devices. Compared with previous researches on electrospinning and electrical poling, our preparation of PVDF film is more convenient and costs less. The polar β crystalline phase in PVDF film is higher and its performance is better. Therefore, we provide a facile and costless approach to obtain self-polarized piezoelectric films with an enhanced polar β crystalline phase and create a dual functional device for pressure sensing and electricity generation.

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1998-2010: Assistant Professor at INSA, Laboratory of Engineering Polymer Materials, Lyon, France
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2013 : Head of National Network “Polymers and Ionic Liquids” GDR CNRS #3585.

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**Current Research Area**
Her research topics are related to i/Processing of nanocomposites materials where fillers dispersion (NTC, silica, clays, oxides) is tailored from physicochemical interactions between fillers and matrix (surface modification, compatibilizer agents) and from processing ways (melt intercalation, solvent cast method, in situ polymerization). A fine characterization of morphologies during processing and in the final state of material (electronic microscopy, x-rays scattering, rheological analysis) were developed to establish the relationships between structuration and physical properties (crystallinity, mechanical, barrier, dielectrical properties, etc.); ii/Processing of mesoporous materials with the use of carbon dioxide in supercritical medium as a foaming agent; iii/Processing of self assembled materials onto inorganic surfaces with the use of phase separation phenomena in polymer blends and of self organization phenomena into di or triblock copolymers to achieve a specific application (nanolithography, optical properties, etc.); iv/Processing of nanomaterials from Ionic Liquids where a wide variety of Ionic Liquids Salts can be used as an efficient compatibilizer, nanobuilding block agent or plasticizer and v/Tailoring of interfaces/interphases in the heterogeneous materials: polymer blends and fiber based composites where the physicochemical modification of interfaces/interphases and the understanding of adhesion mechanisms in composites are investigated.

**Selected Recent Publications**
Ionic Liquids/Polymer: a new promising combination

J.Duchet-Rumeau, S. Livi, S. Pruvost, B.G. Soares, J.F. Gérard

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In the last decade, ionic liquids have moved from relative obscurity to something that most chemists are now very aware of. At present, the interest in ionic liquids shows a continuous increase. They are being examined as new components for designing polymer materials as novel electrolytes in batteries, templates for porous polymers, plasticizers, surfactants in the preparation of functional polymers. The unique set of physico-chemical properties of ionic liquids finely tuned from their chemical structure makes them as ideal components for processing of advanced materials. As shown in Figure 1, ionic liquids can be both i) interfacial agents for tailoring the dispersion state of fillers in nanocomposites [1] and the pore size in the foams [2] or still for enhancing the compatibilization of polymer blends [3]; ii) chemically reactive agents able to initiate the polycondensation of epoxy networks [4]; iii) structuring agents leading to the formation of three-dimensional networks of anions and cations inducing strongly enhanced physical properties [5]. This talk will give a wide overview of the use of ILs in polymer science and will tend to deepen the understanding of specific properties of ionic liquids so that the true potential of ionic liquids in polymer science can be highlighted.

a)  

b)  

c)  

Figure 1. Highlights of ionic liquid role: as a structuring agent (a), compatibilizer (b) and interfacial agent (c)

Current Research Area

The main focus of interest in my research group lies in the development of functional polymer materials with a broad range of porosity scales, and the whole spectrum from their design to their potential applications is investigated. More specifically, original nanoporous materials with controlled morphology and pore functionality are engineered from newly synthesized block copolymers or polymer networks (IPNs, hybrid systems). Such nanoreactors are further used as efficient catalytic supports. More recently, doubly porous polymeric materials are tailored from a double porogen templating approach in order to tune two porosity levels within such novel systems, i.e. nano- and macro-porosity. Electrospun nanofibrous materials are also produced as 3-D biocompatible scaffolds meant for tissue engineering applications.

Selected Recent Publications

Crossing porosity scales in functional polymer materials:

*From design to application*

Daniel Grande

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Over the last decade, the generation of organic porous materials with tunable pore sizes and desired functionalities has been the subject of increasing attention in materials science. Interest in such porous frameworks originates from the large variety of applications in which they are involved, *e.g.* size/shape-selective nanoreactors, monoliths for advanced chromatographic techniques, nanofiltration membranes, high specific area catalytic supports, as well as 3-D scaffolds for tissue engineering.

This lecture examines the scope and limitations of three different approaches to nano- to macro-porous polymers with controlled porosity and functionality. The first approach relies on the synthesis of polystyrene-*block*-poly(D,L-lactide) diblock copolymers with functional groups at the junction between both blocks (*e.g.*, COOH, SO$_3$H, SH), followed by their macroscopic orientation, and the subsequent selective hydrolysis of the polyester block.$^{1,2}$ The second strategy entails the preparation of biocompatible doubly porous crosslinked polymer materials through the use two distinct types of porogen templates, namely a macroporogen in combination with a nanoporogen. To generate the macroporosity, either CaCO$_3$ or NaCl particles or fused PMMA beads are used, while the second porosity is obtained by using either hydroxyapatite nanoparticles or a porogenic solvent.$^{3}$ Finally, 3-D macroporous scaffolds based on biodegradable polyesters have been engineered by electrospinning to generate nanofibrous biomaterials that mimic the extracellular matrix.$^{4,5}$ The potentialities afforded by these approaches will be addressed, and some typical applications of the resulting porous materials will be illustrated.

**References**


2000 : Chemistry, B. S., Hunan University, China
2002 : Applied Chemistry, M. S., Hunan University, China
2005 : Polymer Chemistry and Physics, Ph.D., Changchun Institute of Applied Chemistry, Chinese Academy of Science, China
2005-2006 : Postdoctoral Fellow, University of Alberta, Canada
2006-2009 : Postdoctoral Researcher, University of Massachusetts Amherst, USA
2009 - : Professor, School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, China

**Current Research Area**

The focus of the research done in our group is the design, synthesis of polymer particles with well-defined sizes, shapes, and functionalities. Several strategies and techniques, including microfluidics processing, supramolecular assembly, and nanoprecipitation have been employed to tune the morphology and size of the polymer microstructured materials. We are interested in exploring the applications of the polymer particles with built-in functionalities in the area of optics, diagnostics, delivery and release, and imaging.

**Selected Recent Publications**

Assembly of Block Copolymers in 3D Confined Geometry

Renhua Deng, Jiangping Xu, and Jintao Zhu

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Block copolymer nano-objects have attracted great attention due to their potential applications in the fields of drug delivery, targeting therapy, medical diagnosing and imaging. 3 dimensional (3D) confinement, which can break the symmetry of a structure, has proven to be a powerful route to tailor the morphologies of block copolymer particles. Particle shape and internal structure can thus be tuned by using the supramolecular strategy or tailoring the interfacial interaction of the particles with the dispersed medium.1,2 We will introduce the generation of the nano-objects with well tunable shapes by taking advantage of 3D confined assembly and supramolecular chemistry. Particles with various internal structures can be obtained due to the 3D soft confinement in emulsion droplets. Moreover, we will show that selective disassembly of the structured particles will give rise to mesoporous particles or nano-objects with unique shapes.

Acknowledgement

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Current Research Area
The research team "Structure and Properties of Glycomaterials" is interested in natural polysaccharides from a Polymer and Material Science point of view. This class of polymer is very diversified in terms of structure and represent a great part of the biomass and an almost inexhaustable resource of materials, that can be used to replace oil based materials. In Nature, they are arranged in complex hierarchical structures that exhibit remarkable properties and are elaborated at low energy cost. My scientific interests are focused on the characterization of the ultrastructure of polysaccharides (especially cellulose which is the most abundant) and understand how their specificity (strong anisotropic properties, chirality, lightness…) can be used to design new innovative and sustainable materials, combining classical polymer or soft matter science approaches and bioinspired pathways for applications as different as mechanical reinforcement or optical devices.

Selected Recent Publications
2. M. Wada, L. Heux, Y. Nishiyama & P. Langan, Crystallographic, scanning microprobe X-ray diffraction, and cross-polarized/magic angle spinning $^{13}$C NMR studies of the structure of cellulose III$_{II}$ Biomacromolecules, 10(2), 302-309 2009
Muller, Francois; Jean, Bruno; Perrin, Patrick; Heux, Laurent; Boue, Francois; Cousin, Fabrice
Man-made and bioinspired materials from nanocellulose: challenges and opportunities
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Natural structures exhibit spectacular properties like, for instance, the toughness of wood, the elasticity of primary walls or in the animal kingdom the iridescence of beetle shells. All those properties rely on hierarchical assemblies made of fibrillar nano-elements that fulfill their function at a very reasonable energy cost and a light weight. Among the different possible sources, cellulose is the most abundant polymer produced in Nature. Two types of the so-called “nanocelluloses” are nowadays exploited for their properties i.e. cellulose micro/nanofibrils (MFC/NFC) with almost infinite longitudinal sizes obtained by a mechanical disruption of the original fibers (Figure 1a) or cellulose nanocrystals (CNC) recovered after acid hydrolysis that are rodlike shaped (Figure 2a).

The applications that are considered often requires the modification of their dispersability and hence some kind of surface modification. Nanocelluloses can be prepared as cellulose aerogel (Figure 1b) that can be further hydrophobized [1, 2]. Those aerogels can be directly used after chemical modification for elastomer reinforcement [3] or cellulose can be directly transformed in all cellulose composite [4]. In colloidal suspension, CNCs can be physically covered by surfactants to give stable suspensions in organic solvents that exhibit nice self-organizing properties in organic solvents (Figure 2b) and oriented in external fields. Recently, we also demonstrated that these nanorods bear a permanent dipole moment that allows their orientation under relatively modest electric fields allowing the control of designed helicoidal structures.

Références :
1996: Ph. D. LCPO/University of Bordeaux I (A. Soum), France.
1997-2014: Assistant Professor at University of Strasbourg – ECPM, Department of polymer science (LPMP, LIPHT and ICPEES)
2011: Accreditation to conduct research University of Strasbourg

Thesis: Synthesis and elaboration of polyfonctionnal polymeric materials using intensified process

Since 2015: Assistant Professor at University of Strasbourg – ECPM, Charles Sadron Institute - CMP (CNRS).

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Current Research Area
The main objectives of the research group “Precision Macromolecular Chemistry” at Charles Sadron Institute is to control the molecular structure (i.e. architecture, microstructure and functionality) and, as well, polymer morphology with the aim of developing new polymeric materials. In this perspective, we are particularly interested in correlating the key aspects of polymer synthesis (building-blocks for polymerizations, preparation of tailored macromolecules, …) and the polymerization processing technology. Starting from well-known reactive systems or formulations, we focus on the influence of the process parameters on the final properties of materials. That is why we develop specific intensified reactors i.e microfluidics types in order to improve or control some fundamental parameters in polymer synthesis like the efficiency of mixing or the thermal exchange. Recently, we have interested to produce emulsions in water with a controllable size in range of 30-100nm.

Selected Recent Publications
Using intensified polymerization processes to elaborate novel polymeric materials

Michel Bouquey, Christophe A. Serra, René Muller, Yves Holl

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Properties of polymeric materials not only depend upon the chemical nature of the macromolecules but also of their arrangement at different scales from nano to mesoscale. Moreover these morphologies are strongly affected by the type of polymerization process and by its operating parameters. To assess this affect, our group has developed in the last decade intensified polymerization reactors which, under specific conditions, allowed elaborating new polymeric materials. Two main results in this area will be detailed and discussed during the presentation. The first deals with the use of microfluidic devices to produce size-, composition- and morphology-controlled polymer micro and nanoparticles in the size range 10-600 µm and 40-500 nm respectively\(^1\) (low viscosity systems). The second concerns a new reactor/mixer\(^2\) (so-called RMX®) for the synthesis of polymers in highly viscous media (high viscosity systems). It consists in an in situ polymerization conducted within a melted polymer matrix which induces uncommon morphologies and properties.

References


Current Research Area

My research interests are focused on the fundamental and practical aspects involved in the synthesis of smart colloidal materials with special emphasis on stimuli-responsive polymers grafted inorganic nanoparticles. My research also includes activities on the synthesis of microgels for the elaboration of hybrid materials or using as stabilizers of emulsions.

Selected Recent Publications

Cold Welding or How Soft Interactions Promote the Welding of Colloidal Gold Nanorods

Sen Li, Julien Smith, Simona Laza, Nicolas Sanson

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The increasing interest for the self-organization of metallic nanoparticles is due to its potential use in the construction of functional nano/micro-systems for sensing, photonics and biomolecular electronics. For these reasons, self-organization has become for the last years a major research theme in nanotechnology. One of the main factors determining the final geometry of the resulting assembly is the nanoparticle shape. At present, among anisotropic metallic nanoparticles, there is considerable interest for gold nanorods (GNR) due to their aptitude for bidirectional ordering.

Here we demonstrate a new, soft, fast and simple way to produce long gold nanowires (up to 6µm) based on the end-to-end self-organization and cold-nanowelding of colloidal gold nanorods in water at room temperature and without any external force. The welding of colloidal gold nanorods in water is promoted by polymer/surfactant interactions between CTAB surfactants located on the GNR surface and polymers added in solution. The GNRs self-organization process can be stopped at any time in order to control the length of the gold nanowires. The nature, functionality, concentration and the average molar mass of the polymer added in solution were investigated on the reaction rate. The kinetics of the gold nanowires formation is modelled by a oriented attachment mechanism mimicking a step-growth polymerization in which colloidal gold nanorods act as multifunctional monomer units.

This cold nanowelding technique, based on polymer/surfactants interactions, represents an attractive strategy to the bottom-up production of metallic nanowires and anticipates to be a possible future microfabrication technique with a strong analogy with polymer chemistry.
1987: BS degree from Fudan University, majoring in Chemistry, China
1990: MS degree from Fudan University, majoring in Physical Chemistry, China
1996: PhD degree from Fudan University, majoring in Polymer Chemistry and Physics
1996-1998: Visiting Scientist at Eastern Michigan University, USA
1996-2002: Associate Professor, at Fudan University, China
2002-: Professor, at Department of Macromolecular Science, Fudan University, China
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Current Research Area
The focus of the research done in my group is design and synthesis of various functional polymeric composite microspheres with controlled properties for biomedical applications in imaging, sensing, enrichment, diagnostics and drug delivery.

Selected Recent Publications
Stimuli-responsive biodegradable polymer nanoparticles for triggered drug delivery system

Peng Yang, Sha Jin, Yuanjia Pang, Jia Guo and Chang-Chun Wang

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Cancer can affect various organs and occur in nearly every tissue in the body, which is one of the most challenging medical issues for handling. The modern personal healthcare and pharmaceutical industries have raised some new concepts and requirements for the therapy of cancer, that is, it can be found at the early stages before the cancer metastasizes through the lymph systems and then the abnormal cells can be efficiently killed by chemotherapeutic agents. In this abstract, we have successfully developed a US traced and triggered drug delivery system using a new preparation method, the superiority of their US contrast efficiency and excellent drug-delivery capacity has been confirmed. In comparison with previous reported ultrasound targeted drug release systems, our system has four advantages as following: (1) the PMAA-PFH nanocapsules are very uniform, soft and small (300 nm), which can easily enter the tumor tissues via EPR effect; (2) the PMAA shell has high DOX-loading content (36 wt%) and great drug loading efficiency (93.5 %) by strong electrostatic interactions between carboxyl groups and amino groups, and the loading drug can be quickly released (< 5 min.) under US conditions; (3) the PFH filled can effectively enhance US imaging signal through acoustic droplet vaporization (ADV), ensuring diagnostic and image-guided therapeutic applications; (4) what is more, the disulfide-crosslinked PMAA shell is biodegradable and thus safe for normal organisms. All these merits enabled us attain the final goal for optimizing the balance of diagnostic, therapeutic and biodegradable functionalities in a three-in-one theranostic nanoplatform.

References
(2) Minchinton, A. I.; Tannock, I. F. Cancer 2006, 6, 583-592.
1984-1990: Chemistry major, University of Mainz, Germany
1993: PhD in Theoretical Physics, University of Mainz, Germany
1995-1997: Post-doc, Institut Charles Sadron, Strasbourg, France
1999: Habilitation in Physics, University of Mainz, Germany
As of 1999: Professor for Physics at the University of Strasbourg, France

**Current Research Area**

My research activity is focused on the physics of polymers. Over the last years, I have worked on the conformation and dynamics of bulk polymer melts and thin films, both in the liquid phase and in the glass phase. More specifically, my research has been concerned with the following topics: the corrections to chain ideality in the melt due to residual excluded volume interactions [1], the subdiffusive motion of the center of mass of a polymer in a nonentangled melt [2], the conformation and structure of two-dimensional polymer solutions and melts [3], the structural relaxation of polymer melts and films on cooling toward the glass transition [4,5], the mechanical properties (shear and bulk moduli) of (polymer) glasses [6], the correlation between chain conformation and shear forces when two brush-bearing surfaces are in contact with one another [7], and the tribological properties of glassy polymer films in contact with a nanoindenting tip [8].

**Selected Recent Publications**

We perform molecular dynamics simulations of a coarse-grained model of a polymer-solvent mixture to study solvent evaporation from supported and free-standing polymer films near the bulk glass transition temperature $T_g$. We find that the evaporation process is characterized by three time ($t$) regimes: an early regime where the initially large surplus of solvent at the film-vapor interface evaporates and the film thickness $h$ varies little with $t$, an intermediate regime where $h$ decreases strongly, and a final regime where $h$ slowly converges toward the asymptotic value of the dry film. In the intermediate regime the decrease of $h$ goes along with an increase of the monomer density at the retracting interface. This polymer-rich “crust” is a non-equilibrium effect caused by the fast evaporation rate in our simulation. The interfacial excess of polymer gradually vanishes as the film approaches the dry state. In the intermediate and final time regimes it is possible to describe the simulation data for $h(t)$ and the solvent density profile by the numerical solution of a one-dimensional diffusion model depending only on the $y$ direction perpendicular to the interface. The key parameter of this model is the mutual diffusion coefficient $D$ of the solvent in the film. Above $T_g$ we find that a constant $D$ allows to describe the simulation data, whereas near $T_g$ agreement between simulation and modeling can only be obtained if the diffusion coefficient depends on $y$ through two factors: a factor describing the slowing down of the dynamics with decreasing solvent concentration and a factor parametrizing the smooth gradient toward enhanced dynamics as the film-vapor interface is approached.

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2006-2009: Postdoctoral Research Fellow, Nagoya University, Japan
2010-2011: Research Associate, University of Texas at Austin, USA
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Current Research Area

The research in our group is focus on design and synthesis of optically active helical polymers and exploring their applications in chiral recognition, asymmetric reaction, and enantiomer separation. We focus on developing new catalyst or initiator for facile synthesis of stereoregular helical polyisocyanide and polyallene under living/controlled manner. We are interested in facile synthesis of well-defined hybrid block copolymers and polymer brushes containing helical polymer segments, and explore their self-assembly and the related optical properties. We particularly interested in the applications of chiral materials based on the helical polymers in asymmetric reactions and enantiomer separation with in high efficient.

Selected Recent Publications

Facile Synthesis of Stereoregular Helical Polyisocyanide and Its Copolymers

Zhi-Qiang Jiang, Jia-Li Chen, Ya-Xin Xue, Zong-Quan Wu

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Inspired by the helical structures of natural occurring biomacromolecules, researches on optically active helical polyisocyanides have attracted considerable attentions in recently decades. Well-defined helical polyisocyanides are usually prepared by the polymerization of appropriate isocyanide monomers by using transition metal complexes as initiator or catalyst. However, the living/controlled synthetic method is limited. Here, we report a series of new palladium complexes which can initiate the polymerization of various isocyanide monomer under living/controlled manners, afforded well-defined polyisocyanides in high yields with controlled molecular weights ($M_n$s), narrow molecular weight distributions ($M_w/M_n$s), and interestingly, high stereoregularity. We revealed that the substituents and ligands on the Pd(II) initiator affect the polymerization activity. Additionally, modifications on this Pd(II) complexes, such polymerization can be further applied in the synthesis of copolymer containing helical poisocyanide segments. For example, incorporated norborene unit onto the Pd(II) complex, this Pd(II) initiator can be used to readily synthesis of polymer brushes containing polynorborene as main chain and helical polyisocyanide as side chains. Moreover, introduced a hydroxyl (OH) group onto the Pd(II) initiator, a series of block copolymers compose of stereoregular polyisocyanide and poly(L-lactic acide) can be facilely prepared in one-pot. Given the modification on the Pd(II) initiator and isocyanide monomers, various optically active functional materials can be readily obtained.

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