

# Physical Chemistry

Department of Chemistry  
University of Illinois at Urbana-Champaign

For more information, visit  
[chemistry.illinois.edu](http://chemistry.illinois.edu)



## What is Physical Chemistry?

Physical chemistry studies the physical principles that govern the properties and behavior of chemical systems, both at the macroscopic and at the molecular level, using experimental techniques, theoretical analysis and computer simulation. Equilibrium and nonequilibrium properties of chemical reactions and phase transformations are studied by thermodynamics and statistical mechanics. Electronic structure applies the laws of quantum mechanics to predict chemical bonding and molecular structure. The rates and mechanisms of chemical transformations are studied in chemical kinetics. Experimental techniques range from imaging and mass spectroscopy to laser spectroscopy and magnetic resonance.

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### Mikael Backlund

Optical microscopy, quantum sensing, magnetic resonance, single-molecule and super-resolution microscopy, metrology, biophysics, condensed matter  
[chemistry.illinois.edu/mikaelb](http://chemistry.illinois.edu/mikaelb)



### Martin Gruebele

Dynamics of complex systems by experiments, computation and theory, from single molecule absorption spectroscopy on surfaces to vibrational energy flow in molecules, glass dynamics, protein folding in live cells, and vertebrate behavior  
[chemistry.illinois.edu/mgruebel](http://chemistry.illinois.edu/mgruebel)



### Hee-Sun Han

Development of a new imaging platform for high throughput single molecule imaging in tissues; creation of a microfluidic platform for high throughput single virus sequencing; deciphering multi-level regulatory network in complex biological system  
[chemistry.illinois.edu/hshan](http://chemistry.illinois.edu/hshan)



### So Hirata

Electronic and vibrational quantum many-body theories for molecules, polymers, and solids; computational spectroscopy; high-performance computing; computer algebra for many-body theory formulation and programming  
[chemistry.illinois.edu/sohirata](http://chemistry.illinois.edu/sohirata)



### Nick Jackson

Theoretical soft materials chemistry, electron and ion transport, machine learning applied to molecular and polymeric systems, multiscale all-atom and coarse-grained simulations  
[chemistry.illinois.edu/jacksonn](http://chemistry.illinois.edu/jacksonn)



### Prashant K. Jain

Molecular and nano-optics; plasmonics; near-field manipulation of photophysics and photochemistry; super-resolution imaging of active sites in heterogeneous catalysis; phase transformations in single nanodomains; artificial photosynthesis  
[chemistry.illinois.edu/jain](http://chemistry.illinois.edu/jain)

also see reverse side

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# Physical Chemistry

## Other faculty with interests in Physical Chemistry

### Dana D. Dlott (emeritus faculty)

Laser spectroscopy under extreme conditions

### Robert B. Gennis (emeritus faculty)

Membrane proteins; bioenergetics

### Andrew A. Gewirth

Spectroscopy and microscopy of energy-related interfaces

### Gregory S. Girolami

Chemical vapor deposition; catalysis; molecule-based magnets

### Yi Lu

Computational and spectroscopic studies of proteins, DNA and nanomaterials

### Catherine J. Murphy

Inorganic nanomaterials

### Lisa Olshansky

Spectroscopic interrogation of transient states formed during solar to fuels conversion and within switchable artificial metalloproteins

### Taras Pogorelov (research faculty)

Biomolecular computation

### Charles M. Schroeder (affiliate faculty)

Single-molecule studies of polymers and biomolecules

### Kenneth S. Suslick (emeritus faculty)

Sonochemistry; sensor arrays

### Jonathan V. Sweedler

Neurochemistry; cell-cell signaling pathways

### Emad Tajkhorshid

Computational structural biology and molecular biophysics; membrane proteins; drug design



### Deborah E. Leckband

Kinetics and thermodynamics of biological recognition and bio-adhesion; single molecule techniques; molecular force probes; molecular dynamics simulations; measurements of binding between single cells

[chemistry.illinois.edu/leckband](http://chemistry.illinois.edu/leckband)



### Zaida Luthey-Schulten

Simulations of *in vivo* stochastic processes in single cells and colonies using GPUs; physics of metabolic networks; evolution of translation; dynamical networks of protein-RNA interactions; statistical mechanics of the genome and DNA replication

[chemistry.illinois.edu/zan](http://chemistry.illinois.edu/zan)



### Nancy Makri

Development and application of path integral and trajectory-based methods for simulating quantum dynamical processes in the condensed phase

[chemistry.illinois.edu/nmakri](http://chemistry.illinois.edu/nmakri)



### Ralph G. Nuzzo

The chemistry of materials; nano and micro-scale fabrication; soft materials; integrated devices; self-organizing structures

[chemistry.illinois.edu/r-nuzzo](http://chemistry.illinois.edu/r-nuzzo)



### Eric Oldfield

Drug discovery using NMR, X-ray, and computational methods

[chemistry.illinois.edu/eoldfiel](http://chemistry.illinois.edu/eoldfiel)



### Kenneth S. Schweizer

Statistical mechanical theory of the structure, phase behavior, properties and dynamics of soft materials composed of molecules, polymers, colloids, and nanoparticles in the liquid, crystal, glass and gel states

[chemistry.illinois.edu/kschweiz](http://chemistry.illinois.edu/kschweiz)



### Renske M. van der Veen

Ultrafast electron microscopy; ultrafast X-ray science; laser spectroscopy and microscopy; excited-state structural dynamics; photoswitching, photocatalytic and photovoltaic materials

[chemistry.illinois.edu/renske](http://chemistry.illinois.edu/renske)



### Josh Vura-Weis

Tabletop femtosecond X-ray spectroscopy of excited-state nuclear and electronic dynamics in transition metal complexes, focusing on short-lived states in inorganic catalysts and photomagnetic materials

[chemistry.illinois.edu/vuraweis](http://chemistry.illinois.edu/vuraweis)

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