IUPAP Commission 6

Nano in Biological Physics

Working Group on Nanoscience

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Biological Research Center

Szeged, Hungary
# Program/Symposia
## 5th International Conference on Biological Physics
--- ICBP2004 Gothenburg, Sweden ---

- Single molecule studies
- Nanotechnology and surface science in biology
- Biosensors and medical applications
- Charge transfer in biomolecules, and photobiology
- Structure and dynamics of biomolecules (Protein folding)
- Dynamical models of DNA
- Physics of subcellular structures
- Modelling aspects of cell biology
- Physics of the neural system
- Evolution and origin of life
- Complex systems in biological physics
- General Biological Physics/Others
• **Optical Explorations of Single Molecules** W. E. Moerner. *Stanford University, USA*
• **Biofunctional Supramolecular Interfacial Architectures for Optical Biosensing** Wolfgang Knoll. *MPI Mainz, Germany*
• **Single Macromolecules: Hierarchic Thermodynamics, Irreversability and Biological Function** Kenishi Yoshikawa. *Kyoto University, Japan*
• **Single Particle Manipulation by Microstructures Generated and Operated by Light** Pal Ormos. *Szeged University, Hungary*
• **Direct Observations of Tiers in the Energy Landscape of a Protein: A Single Molecule Study** Jürgen Köhler. *University of Bayreuth*
• **LexA-DNA Bond Strength by Single Molecule Force Spectroscopy** Lilian T. Costa. *LM University, Munich, Germany*

**Break 16:20-16:40**
• **Single Molecule Spectroscopy with Vibronic Excitations** Andreas Zumbusch. *University of Munich, Germany*
• **Atomic-scale Dynamical Single Molecule Observations Using X-rays** AYuji C. Sasaki. *JASRI, Sayou-gun, Hyougo-ken, Japan*
• Ions Crossing a Viral Ion Channel: Steered Molecular Dynamics Simulations on Vpu from HIV-1 Wolfgang B. Fischer. University of Oxford, UK

• Novel Fluorescent Proteins for Molecular and Cellular Biophysics Studies Gerd Ulrich Nienhaus. University of Ulm, Germany

• Bilayers in a Supporting Role: Tethered Vesicles and Composition Analysis Steven G. Boxer. Stanford University, USA

• Molecular Recognition in 2D Binary Mixtures of DNA-Base Molecules Studied by STM Maya Schöck. University of Aarhus, Denmark

• Spontaneous Stretching of DNA in Nanofluidic Channels Jonas O. Tegenfeldt. Lund University, Sweden

• Protein Surface – the Dynamics of the Interactions between Protein, Water and Small Solutes Ran Friedman. Tel Aviv University, Israel

• Molecular Recognition Based on Optical Spectroscopy of Single Gold Nanoparticle Gunnar Raschke. LM University, Munich, Germany

• Target Specificity of a Peptide Aptamer Selected against Titanium Kiyotaka Shiba. Tokyo Cancer Institute, Japan

• Enzymatic Reactions in Biomimetic Confined Containers of Liposomes Kristin Sott. Chalmers UT, Göteborg, Sweden
What is a protein?

A linear chain of amino acids, the length is typically several hundred units
What is a protein?

It has a well defined structure, can perform most complex functions
Characteristics of „nano”

The object of biological studies is often by nature of nano scale, but in general they are not regarded as nano.

Single molecule approach is by convention also called nano.

Key question: what extra information is obtained from SMA? Great progress lately.
NanoExamples in Biology: Muscle

The force generating tissue
Muscle

The myosin „walks” along the actin filament
Muscle

Myosin walk studied by optical tweezers
The structural component titin is unfolded by mechanical force
Single unfolding events are observed
Single protein folding
Rotating ATPase

Energy from ATP hydrolysis is transported to the proton pump by rotating axle
Rotating ATPase
DNA properties

C. Bustamante, Berkeley
DNA mechanical engine

Yurke et al.
Bell Labs, Oxford Univ.

Nature 406, 605 - 608 (2000);
Other areas

• Single molecule spectroscopy
• Any molecular dynamics calculation can be regarded as nano
• Biomolecules arranged on surfaces
• Matter encapsulation, membrane thethers
• etc
Examples of BioNanotechnology

Material transport with „walking” biological molecules

Henry Hess,
Dept of Bioengineering
Center for Nanotechnology
University of Washington
Seattle, WA
Steering of material transport

**Guiding channels**

**Chemically modified channels**

J. Clemmens et al.: “Analysis of microtubule guidance by microfabricated channels coated with kinesin”, Langmuir
Molecular filters

Bacterium covered with S-layer

Molecular filter built from S-layer proteins

Center for Nanotechnology, Wien
Uwe B. Sleytr
DNA based structure building

Chad Mirkin, Northwestern Univ.

DNA is a special polymer: its length and composition can be perfectly regulated.
DNA based structure building
DNA based structure building

L. Johnson, Oxford Univ.
ATPase in technology

Molecular pumps driven by rotating ATPase

j. Montemagno, Cornell