Discreteness of Chemically Reacting Systems: Time Fluctuation Analysis

Taichi Haruna (1) ((1) Graduate School of Science, Kobe University; PRESTO, JST)

We consider chemically reacting systems whose time evolutions are governed by Chemical Master Equations (CME) in order to investigate the discrete nature of chemical reactions. Recently, the author proposed a new approximation scheme to bridge CME and Chemical Fokker-Planck Equation (CFPE) [T. Haruna, *J. Comp. Chem. Jpn.*, submitted]. In this scheme CFPE is approximated by a sequence of master equations parameterized by a parameter ε ($0 < \varepsilon \leq 1$). We obtain CME for $\varepsilon=1$ and CFPE as $\varepsilon \rightarrow 0$. Thus ε can be interpreted as a degree of discreteness. We calculate the temporal fluctuation spectrum for each ε in order to see how the discreteness affects the dynamics of chemically reacting systems. The temporal fluctuation spectrum characterizes how the local average over a finite duration approaches the ensemble average as the duration becomes large. We also propose a new theory to approximately calculate the temporal fluctuation spectrum by making use of the WKB approximation for the generating function.

2P-254 集団ダイナミクスにおけるノイズ強度のシステムサイズ依存性はネットワーク構造が決定する

Structure of networks determines the system size dependency of noise intensity in collective dynamics

Naoki Masuda (1), Yoji Kawamura (2), **Hiroshi Kori** (3) ((1) University of Tokyo; (2) JAMSTEC; (3) Ochanomizu University)

see 2TP3-01

2P-255 クラミドモナスにおける光誘導倒立生物対流の細胞ダイナミクス Cellular dynamics of light-induced inverted bioconvection in *Chlamydomonas reinhardtii*

Naoki Sato (1) ((1) University of Tokyo, Graduate School of Arts and Sciences)

see 2TP3-02

2P-256 二面偏波式干渉技術を用いた熱応答性高分子の分子ダイナミクス解析

Molecular Dynamics of thermal response polymer using dual polarization interferometry

Kohei Shiba (1), Takeshi Mori (1), Takuro Niidome (1), Yoshiki Katayama (1) ((1) Kyushu University)

Poly-N-isopropylacrylamide (poly-NIPAAm) is an intelligence polymer which changes its tertiary structure. The transfer temperature of poly-NIPAAm is around 34 °C, close to human body. That's the reason that it is used for a new material of drug delivery system (DDS) applied this thermal function recently. The solution looks optically clear at room temperature and it becomes clouded above 34 °C. It is well known a transfer temperature by monitoring turbidity at 660 nm. On the other hand molecular dynamics of poly-NIPAAm is determined by NMR and the detail is that it constricts above the transfer temperature. At this study, we present the size decrease of poly-NIPAAm by dual polarization interferometry. We compared the difference of thickness from chip surface at 20 or 36 °C. The thickness at 20 as around 2-3 nm and less than 1 nm at 36 were provided by this method. To be more precise, the mass was dramatically decreased depending on increasing temperature, even the density of the surface increased, and this reaction is invertible. It is suggested that the reason of mass decrease is water molecules got away from this polymer, and it may be more hydrophobic than one at lower temperature.

2P-257 超高速リアルタイム PCR 装置を用いた非特異的 DNA 断片増幅の抑制

Minimized Non-specific Amplification with A Rapid Denaturation to Annealing Temperature Transition Using Novel Ultra Rapid Real-Time PCR system

Hideyuki Terazono (1), Hiroyuki Takei (3), Kenji Yasuda (2) ((1) Kanagawa Academy of Science and Technology; (2) Kanagawa Academy of Science and Technology; Department of Biomedical Information, Division of Biosystems, Institute of Biomaterials and Bioengineering, Tokyo Medical and Dental University; (3) Kanagawa Academy of Science and Technology; Faculty of Life Science, Toyo University)

The polymerase chain reaction (PCR) is the key technology in genome-based biological analysis, and has revolutionized many life science applications like medical diagnostics, food hygiene, and anti bio terrorism. We have developed a novel rapid real-time PCR system using the direct absorption of an infrared (IR)

laser beam with nL water droplets in oil. The system consists of an invert optical microscope, an oil chamber with a set of water droplets lined up at the bottom, a 1480 nm IR laser unit, which is absorbed by water and can be focused on the droplets in the oil chamber, and an fluorescence image intensifier to quantify the PCR reaction within water droplets by measuring the change of fluorescence intensity. This system allows rigorous optimization of the times and temperatures required for each stage of the PCR, and decreasing the required amplification time. The feature of this system is the temperature transition between high and low was within 1 and 0.8 s respectively. Using the system, rapid amplification was observed, and the procedure was accomplished within 3.5 min, including the initial heating and complete 50 PCR cycles. Usually, the slow transition of temperature from denature to annealing/extension yields non-specific DNA fragments. The prevention of the non-specific DNA fragments need a rapid temperature cycling system. Rapid temperature change allows minimized non-specific amplification as well as decreasing the required amplification time. Product specificity was improved with rapid heat exchange when compared to slower conventional heat block cycling. In the meeting, we will present the detailed results and will discuss the potential of our method.

2P-258 細胞内の局所的な温度変化の測定とその解析

Measurement and analysis of local temperature change inside living cells.

Kotaro Oyama (1), Madoka Suzuki (2), Vadim Tseeb (3), Fumichika Ono (4), Yusuke Seto (4), Masahiro Motoyoshi (1), Kaoru Iwai (5), Shin'ichi Ishiwata (3) ((1) Pure and Applied Physics, Graduate School of Advanced Science and Engineering, Waseda University; (2) COBRI, Comprehensive Research Organization, Waseda University; (3) Department of Physics, Faculty of Science and Engineering, Waseda University; (4) Bioscience and Biomedical Engineering, Graduate School of Advanced Science and Engineering, Waseda University; (5) Department of Chemistry, Faculty of Science, Nara Women's University)

see 2TA3-09

2P-259 人口平面膜法と AFM を融合させた膜蛋白質の電流、力同時計測手法の開発

Combined AFM and channel recording system for electrophysiological and dynamic channel function research

Mitsunori Kitta (1), Hiroyuki Tanaka (1), Tomoji Kawai (1) ((1) the Institute of Science and Industrial Research, Osaka University)

Membrane proteins produce some electrical signals by allowing ions to move between the inside and outside of the cell. And this electrical signal is necessary for cell activity such as nervous system in the myocardium. Thus it is physiologically important to study the function of ion-channel. Under this situation, an epoch-making method called Patch-clamping developed by Neher and Sakmann in 1976, enabled us to understand the channel activity in electrophysiological manner, and this was the beginning of developing various techniques for channel research. Especially artificial lipid bilayer system is generally used for channel research, due to its simple and well-defined components. Recently, attention is focused on some research dealing with protein-protein interaction force spectroscopy and imaging on lipid bilayer membrane using Atomic Force Microscopy (AFM). And developing a new combined technology of a channel recording system and AFM is expected to allow us to understand a membrane protein in terms of electrically and dynamically. Here, we describe a research to develop a simultaneous measuring system on electrical current and physical force. And we are going to measure a membrane current and force spectroscopy in simultaneously.

2P-260 神経突起内ミトコンドリアの光学距離と膜電位

Optical distance and membrane potential of mitochondria in neurites

Keisuke Haseda (1), Kazuhiro Kajiyama (1), Yoshihiro Ohta (1) ((1) Div. Biotechnology and Lifescience, Tokyo University of Agriculture and Technology)

Fluorescence measurements of mitochondria with potential sensitive dyes have been revealed that mitochondrial membrane potential (MMP) is not uniform in a cell. In this study, to understand the regulation mechanism of MMP, we studied the relationship between the optical distance and the membrane potential of mitochondria. The optical distances were calculated from phase differences between lights through mitochondria and the lights in the background, the phase differences were measured with the retardation modulated differential interference contrast microscope (RM-DIC). MMPs were estimated by detecting fluorescence of membrane potential sensitive dyes, TMRE or JC-1.

Since the optical distance depends on the density and thickness of mitochondria, we compared mitochondria in neurites with similar widths to suppress the effects of the thickness on the optical density. In neurites, mitochondria were detected as places with the large optical distances. The lengths of mitochondria detected with TMRE fluorescence and RM-DIC were the same. The places with brighter TMRE fluorescence showed the larger optical distances, although there were several