第 67 回　コロイドおよび界面化学討論会　一般シンポジウム S3

Engineering of Bio-active matter: Cross-bridge between materials science and life science

日時：討論会第３日目　平成２８年９月２４日（土）９：００～１２：００
会場：北海道教育大学旭川校（北海道旭川市北門町９丁目）C 会場（N123 教室）
提案者：角五　彰（北大）新田　高洋（岐阜大）横川　隆司（京大）

【企画趣旨】

近年，バイオアクティブマターを利用した生命機能の解明と工学的な応用を目指す研究が行われている．両者は，互いに方法論などを共有しあいながら共に発展してきた．本シンポジウムでは，このふたつの流れの研究者を呼び，最新の動向について議論するとともに，ふたつの流れの新たな統合を目指した議論を深めたい。

プログラム

9:00–9:40 【基調講演】 Engineering with biomolecular motors

○Henry Hess （Columbia University）

Motor proteins, including kinesin, can serve as biological components in engineered nanosystems. A proof-of-principle application is a “smart dust” biosensor for the remote detection of biological and chemical agents, which is enabled by the integration of recognition, transport and detection into a submillimeter-sized microfabricated device. The development of this system has revealed a number of challenges in engineering at the nanoscale, particularly in the guiding, activation, and loading of kinesin-powered molecular shuttles. Overcoming these challenges requires the integration of a diverse set of technologies, illustrates the complexity of biophysical mechanisms, and enables the formulation of general principles for nanoscale engineering.

9:40–10:20 【基調講演】 Soft matters containing nanometer-scale protein motors and micrometer-scale protein filaments spontaneously generate various types of large-scale active pattern

○大岩　和弘[1,2,3]

(1:(国)情報通信研究機構　未来ICT研究所, 2:兵庫県立大学大学院生命理学研究科, 3:CREST　生命動態、JST)

Protein motors and protein filaments play important roles in the diverse cellular activities. To elucidate their spatiotemporal dynamics, we developed model systems composed of purified components. Surface-bound protein motors, dyneins, drive protein filaments on the surface in the presence of ATP and ensemble of these protein filaments were self-organized into the lattice of millimeter-scale vortices. The mixture of microtubules and tetrameric kinesin motors generated three distinct 3-D network structures in the presence of ATP. Coarse-grained models we developed well reproduced experimental results. Our model system brings new insights into cytoskeletal mechanics and the development of self-regulating active materials.

10:20–10:40 【依頼講演】 Creation of phototactic liposome by photo-responsive peptide

○松浦　和則[1]，植村　明仁[1]，稲葉　央[1]，古曳　泰規[2]，重永　章[2]，大高　章[2]

(1:鳥取大院工, 2:徳島大院薬)

Spaciotemporal control of peptide nanofiber growth was achieved by photocleavage of a DNA-conjugated β-sheet forming peptide which is linked through a photoresponsible amino acid residue. Peptide nanofibers were selectively formed by photocleaving the conjugate on complementary DNA-immobilized glass substrate and giant liposome. Photo-cleavage of the conjugate on phase-separated giant liposome caused phototaxis of giant liposome due to Marangoni convection.

10:40–11:00 【依頼講演】 Development of a new method for evaluating cell mechano-response to multidirectional and anisotropic mechanical strain by using photodegradable hydrogel

○吉川　洋史[1]，池滝　憲太郎[1]，柳川　史樹[2]，川村　隆三[1]，呉　國愷[1]，田中　泰誠[3]，小嶋　勝[3]，新井　健生[3]，米山　鷹介[4]，伯野　史彦[4]，高橋　伸一郎[4]，高木　俊之[2]，金森　敏幸[2]，中林　誠一郎[1]，杉浦　慎治[2]

(1:埼玉大学　大学院理工学研究科, 2:産業技術総合研究所　幹細胞工学研究センター, 3:大阪大学　大学院基礎工学研究科, 4:東京大学　大学院農学生命科学研究科)

We have developed a new method for evaluating cell mechano-response to multidirectional and anisotropic mechanical strain. This method utilizes photodegradable gelatin substrate of which local expansion can be triggered by UV irradiation. By adjusting UV irradiation patterns, we can apply mechanical strains with various magnitude and directions to adherent cells, which is not easily available by conventional methods using electric actuators. In the presentation, we will explain the further details of this method and also show dynamic change in shape and local structures of cells induced by various mechanical strains.

11:00–11:20 【依頼講演】 Imaging of amyloid aggregation by quantum dots and its application for screening of aggregation inhibitors

○徳楽 清孝（室蘭工業大学）

Assembly of cytoskeletal proteins is essential for diverse cellular functions, whereas assembly of amyloid proteins triggers the pathogenesis of neurodegenerative disorders, such as Alzheimer's disease (AD), Parkinson's disease, Huntington's disease, and prion diseases. Recently, we reported real-time imaging and quantification of amyloid β (Aβ) aggregates by quantum-dot (QD), and subsequently developed a microliter-scale high-throughput screening (MSHTS) system for the aggregation inhibitors, which may have preventive and /or therapeutic potential for AD, using its imaging technology. In this presentation, I will talk about the methodology of MSHTS system and the results of the screening by the system.

11:20–11:40 【依頼講演】 自律駆動型ナノロボットを用いた細胞の能動輸送

○横川 雅俊，吉積 義隆，鈴木 博章（筑波大学）

In recent years, the term "micro-machine" has become popular and significant progress in artificial self-propelled micromachines has been achieved. However, well-controlled movement of motors, where each motor can perform tasks cooperatively and autonomously, has never been demonstrated. Here, we focus on the autonomous control of micromotors' function, such as movement, capture, and delivering. The unique function is realized by a simple principle based on mixed potential theory, which is used to explain metal corrosion. Therefore, the idea for controlling the functions of machines is not limited to applications, but can be used in various areas of science and technology.

11:40–12:00 【依頼講演】 Self-organized Contractile Fibers of Microtubules and Kinesins

○平塚 祐一[1]，新田 高洋[2]（1:北陸先端大，2:岐阜大）

In living cells, motor proteins and cytoskeletons are ubiquitous, and involved in various cellular functions. The functions are performed through distinct self-organized subcellular structures, such as contractile rings and stress fibers. Inspired by this, we intended to develop a molecular system consisting of microtubules and kinesins which can self-organize into various morphologies. By using a genetically engineered kinesin, we found that microtubules and the kinesins were self-organized into contractile fibers. In this presentation, we will discuss the mechanism of formation of the contractile fiber, and their possible applications as a novel actuator for microdevices.

12:00–12:20 【一般講演】 Construction of peptide nanocapsule bearing coiled-coil on the surface

○藤田 聖矢[1]，山本 翔也[2]，松浦 和則[1]
（1:鳥取大院工，2:鳥取大工）

We have previously reported that *β*–Annulus peptide (INHVGGTGGAIMAPVAVTRQLVGS) from tomato bushy stunt virus self–assembled into peptide nanocapsule with the size of 30–50 nm in water and the peptide nanocapsule was dressed up with gold nanoparticles and protein. In this study, we have tried to construct peptide nanocapsule bearing coiled-coil on the surface. *β*-Annulus peptide bearing coiled-coil forming sequence at C-terminal was synthesized by native chemical ligation. TEM image of mixture of the peptide and coiled-coil-A showed spherical assemblies with irregular surface. CD spectrum of the mixture indicates formation of coiled-coil.

基調、依頼講演は、提案者により本シンポジウムのプログラムとして設定されたもので、討論会委員会によるものではありません。

所属は申込みフォームをそのまま反映させているため、各講演者毎にフォーマットが異なる場合があります。

◆参加方法他
本シンポジウムは「第67回コロイドおよび界面化学討論会」のプログラムの中で行われます。詳細は同討論会のHP http://colloid.csj.jp/div_meeting/67th/index.htmlを御確認下さい。

◆お問合せ

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