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利用形態 : 機器利用  
利用課題名(日本語) :  
Program Title (English) : Study of the *Synechocystis* sp. PCC 6803 cells in response to environmental stress by using on chip space-time control  
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## 1. 概要(Summary)

*Synechocystis* sp. PCC 6803 is a kind of model organism for the study of photosynthesis, biofuel and environmental stress adaptation. By dynamically and spatially controlling the environment around cell on the microfluidic chip, we hope to investigate the dynamic mechanical properties of the cell in response to environmental change. Wild type and mutant type cells will be measured. By comparing their viscoelasticity and other mechanical properties, we can understand the function of different ion-channels in the cell adaption mechanism quantitatively.

## 2. 実験(Experimental)

### 【利用した主な装置】

両面露光用マスクアライナ(Suss Micro Tec AG 製 MA-6)、両面露光用マスクアライナ(Suss Micro Tec AG 製 MJB-3)、マスクアライナ(ナノテック製 LA410)、スプレーコーター一式(サンメイ製 DC110)、レーザ描画装置一式(Heidelberg 製 mPG101-UV)、スパッタリング装置一式(キャノンアネルバ製 E-200S)、3次元レーザ・リソグラフィシステム一式(Nanoscribe 製 フォトニック・プロフェッショナル)、3次元レーザ・リソグラフィシステム一式(KISCO 製 SCLEAD3CD2000)、ナノインプリント装置一式(SCIVAX 製 X-300 BVU-ND)、パリレンコーティング装置一式(KISCO 製 DACS-LAB)、小型微細形状測定機一式(小坂研究所製 ET200)、蛍光バ

イオイメージング装置一式(共焦点レーザ顕微鏡システムニコン製 A1Rsi-N)、ICP エッチング装置一式(サムコ製 RIE-800)、ECR スパッタリング装置一式(エリオニクス製 EIS-230S)、高精度電子線描画装置一式(日本電子(株)製 SPG-724)、SEM 用断面試料作製装置(日本電子(株)製 SM-09010)、デジタルマイクロスコープ一式(KEYENCE 製 VK-9700)、ダイシングソー装置(DISCO 製 DAD522)、リアクティブイオンエッチング装置(サムコ製 RIE-10N)、マルチマテリアル 3D プリンタ(RICOH 社製 ProJet5500X)

### 【実験方法】

Firstly, rectangular substrate chips are cut out from the wafer using a dicing saw. The photoresist on the silicon chips and glass chips are patterned using a mask aligner. The mask used in the patterning process is manufactured by a laser drawing device. After that, metal film formation is performed by using a sputtering device. Then chips are etched by an ICP etching device and a deep Si etcher. Then, the etched glass chip and silicon chip are bonded together by a bonding device. Finally, the backside of the bonded chip is patterned again and etched. Thus, the chip used in our experiment is fabricated

## 3. 結果と考察(Results and Discussion)

The microfluidic chip utilized in this research was

made of silicon on insulator (SOI) wafer consisting of three layers, a device layer, an intermediate oxide layer and a substrate layer. A stretchable pushing probe and a beam type force sensor were formed in the device layer by microfabrication technology. The pushing probe was connected to the thick silicon substrate layer via the intermediate oxide layer. In this way, we actuated the probe by pushing the thick substrate using a piezo actuator.

The target cell was moved to the gap between the pair of probes by optical tweezer and then compressed. By measuring the displacement of the pushing probe and the force sensor, we evaluated the stiffness of the cell, successfully.

#### 4. その他・特記事項 (Others)

・共同研究者:名古屋大学未来社会創造機構 新井史人教授

#### 5. 論文・学会発表 (Publication/Presentation)

- (1) Chang, Di, et al. "Measurement of the mechanical properties of single *Synechocystis* sp. strain PCC6803 cells in different osmotic concentrations using a robot-integrated microfluidic chip." *Lab on a Chip* 18.8 (2018): 1241-1249.
- (2) Chang, Di, et al. "Mechanical Characterization of a Single Yeast Cell Using a Robot Integrated Microfluidic Chip." 2018 International Symposium on Micro-Nano Mechatronics and Human Science (MHS). IEEE, 2018.

#### 6. 関連特許 (Patent)

なし.