課題番号 : F-14-UT-0126

利用形態 : 技術補助

利用課題名（日本語） : マイクロヒーターによる細胞の熱的観測

Program Title (English) : Thermal Cell Monitoring with a Micro-heater.

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1. 概要（Summary）

Nanotech Platform has been used in this project for the fabrication of the masks for the lithography of some micro-heaters patterns.

The purpose of the present project is to monitor the growth of cell culture using a resistive micro-heater. The micro-heater has been fabricated by micro-machining.

The principle of the system is to measure and record the thermal exchange between the micro-heater and its surrounding. The recorded data characteristics differ according to the presence or not of cells, and the rate of occupation on the micro-heater. Information on cells can be calculated by extracting some particular parameters from the recordings.

Compared to other methods, which are already applied for the monitoring of cells culture, this one is quite simple and low cost.

Figure 1 presents the principle of the system, and the location of the micro-heater.

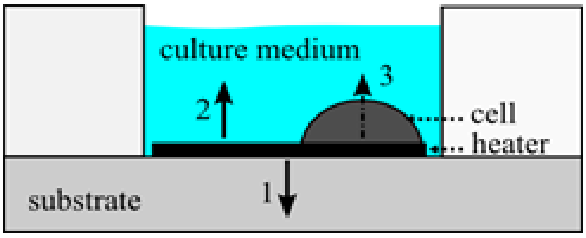

Figure 1: Thermal exchange in a cell culture. The cells are cultured above the micro-heater. This one is also a source of thermal power. There is also: (1) thermal conduction through the device, (2) thermal exchange with the culture medium and (3) thermal conduction through the cell adherent on the surface.

2. 実験（Experimental）

The micro-heater consists on chromium/gold serpentine like patterns fabricated onto a glass substrate. Standard micro-fabrication technique has been used: deposition of the Cr/Au metal layer, then lithography, then etching according to the lithography mask. The first step consists in depositing 20 nm chromium, then 25 nm gold layer on a cleaned glass substrate. Then, the lithography step is following using the Electron Beam glass mask, fabricated thanks to Nanotech Platform at the Takeda Sentanchi Clean-Room, as a UV mask. Lithography has been performed on a UV sensitive Shipley positive resist S1805. Finally, wet etching of gold, then chromium, was performed. At the end, the resist mask was removed by aceton bath and ultra-sounds. Figure 2 presents the picture of one micro-heater after fabrication.

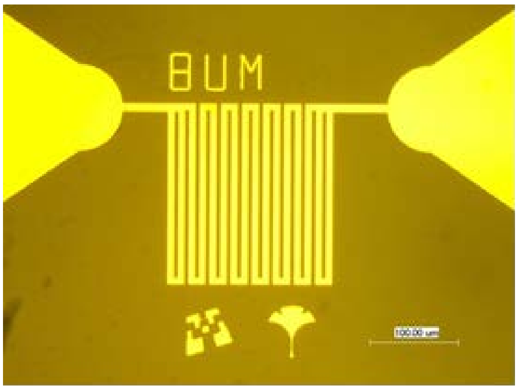

Figure. 2: Picture of a gold micro-heater, with a 8 μm wide resistor serpentine.

Thermal experiments have then been performed using particles covering some part of the micro-heater.

The fabricated micro-heater is the key element of the monitoring system. It is used as well as a heat source as a temperature sensor. The thermal conductance and the heat capacitance of micro-particles are different from the ones of the liquid medium. It means that their thermal physical characteristics are different. As a consequence, when some heat power is induced by the micro-heater, a temperature variation can be measured when there is presence or absence of micro-particles.

3. 結果と考察(Results and Discussion)

A thermal model has been developed in order to extract some parameters like the static gain, in function of the heat power by the micro-heater.

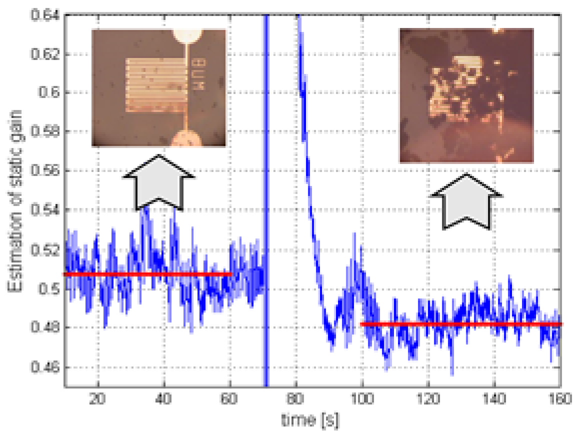

Figure 3: Estimated static gain before and after introduction of particles at t=70 s with associated inset pictures

The static gain before and after the introduction of the particles has been estimated, and is presented on Figure 3.

These first results demonstrate the possibility to use thermal technique for the monitoring of cells culture.

4. その他・特記事項(Others)

なし

5. 論文・学会発表(Publication/Presentation)

Matthieu Denoual, Mathieu Pouliquen, Agnès Tixier-Mita, Hiroyuki Fujita, Hiroshi Toshiyoshi, "Toward Thermal Cell Monitoring – Operating Principle and First Experiments", The 31th Sensor Symposium on Sensors, Micromachines and Applied Systems, Oct. 20th – 22nd 2014, Matsue, Japan.

6. 関連特許(Patent)

なし