

# 手術シミュレータのための温度履歴インジケータ



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## 臓器モデル内の最大温度履歴分布を可視化する

### Background

#### Surgical simulation using animal organs



Porcine heart

クロスメディカル <http://www.xcardio.com/products/standard.html>

#### Limitations

- cost
- operable place
- animal experiment
- Difference between human and animal



#### Surgical simulator of artificial model



Heart model

クロスメディカル  
<http://www.xcardio.com/products/standard.html>

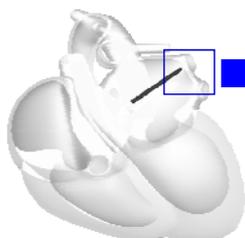


Endo Vascular Evaluator(EVE)

ファイン・バイオメディカル <http://fain-biomedical.com/>

- Good: Reproducibility of shape
- Poor: Reproducibility of physiological properties
- Low functionality

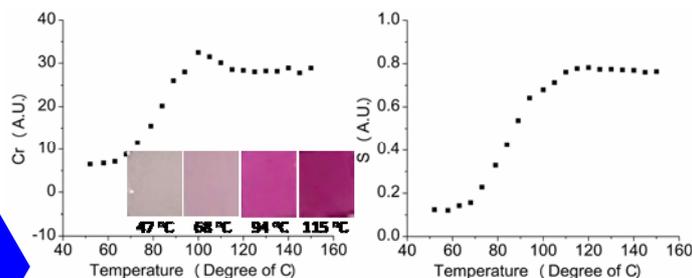
### Concept: Temperature indicator



- Polydimethyl siloxane
- Thermochromic dye
- From no color to magenta

Fabricated indicator ( 100 μm in thick)

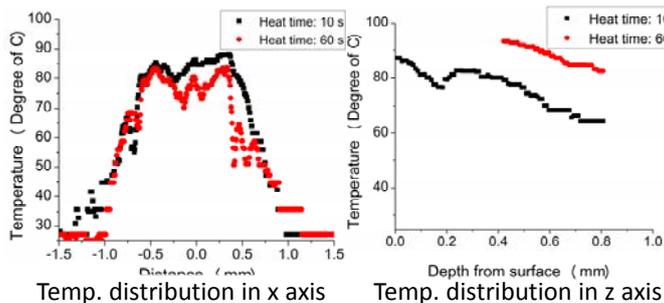
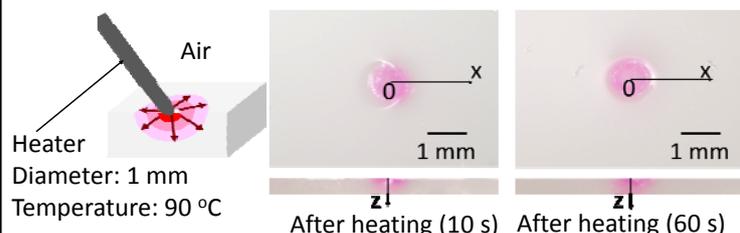
### Calibration with YCrCb HSV color space



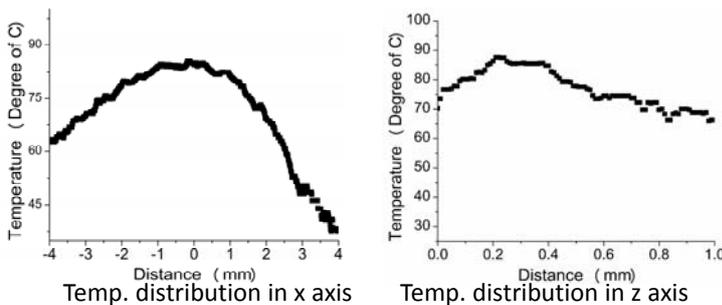
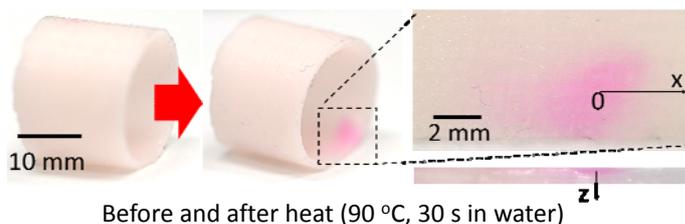
Temperature Accuracy:  
 $\pm 2.0\text{ }^{\circ}\text{C}$  ( 50-94  $^{\circ}\text{C}$  ),  $\pm 1.6\text{ }^{\circ}\text{C}$  ( 94-115  $^{\circ}\text{C}$  )

### Experiment

#### Temperature measurement of membrane



#### Temperature measurement of vascular model



### Reference

特願2015-99716, 2015年5月15日,  
 臓器モデルとその製造方法および温度インジケータパッチ

### Conclusions

- Development of Temperature indicator (50-115 $^{\circ}\text{C}$ , Accuracy:  $\pm 2.0\text{ }^{\circ}\text{C}$ )
- Visualization of 3D Temperature distribution in the simulator

