

# 温度表示機能を有するハイドロゲル血管モデル



NAGOYA UNIVERSITY

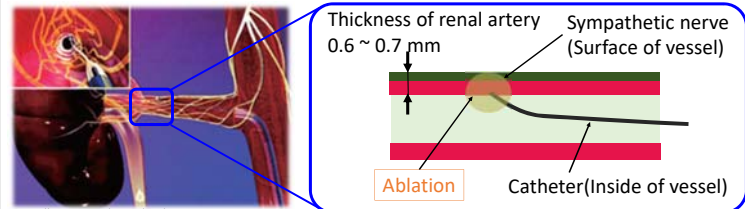
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## Fabrication of sensor integrated artery model with thin and uniform thickness

### Background & Purpose

#### Renal artery ablation for treatment of high blood pressure



Possibility of **vessel damage due to overheating** and **insufficient heating of sympathetic nerve**

Surgical simulator having temperature sensor is needed.

#### Requirements for renal artery model having sensor



- Thickness of vessel : 0.6 to 0.7 mm
- **Uniform thickness** of vessel
- Integration of temperature sensor in hydrogel vessel model

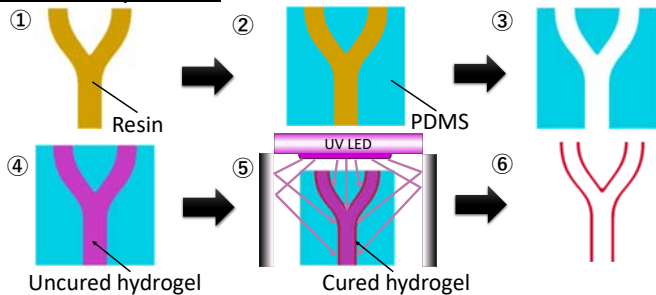
#### Problems on model fabrication

- Molding : Remove the core
- Dip coating: Form uniform thickness

Fabrication of hollow branch structure made of hydrogel with thin and uniform thickness is required.

### Fabrication

#### Fabrication process



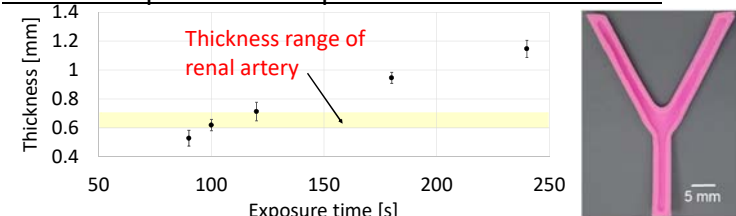
1. Fabrication of mold of vessel model
2. Molding to polydimethylsiloxane (PDMS)
3. Remove vessel mold from PDMS mold
4. Injection of material of vessel model
5. UV exposure from outside the mold
6. Remove uncured material and mold

#### Materials of renal artery model having temp. sensor

PEG-DA 600	PVA 417	DI water	Irgacure1173	50% Chromiclor
40 g	9 g	81 g	2.2 g	2.35 g

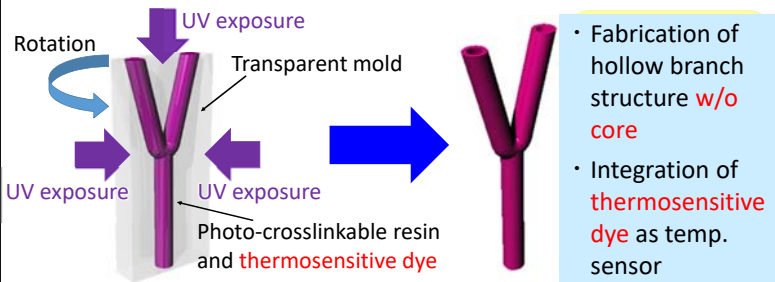
Chromiclor (MATSUI SHIKISO CHEMICAL CO.,LTD) **changes color at 38 °C reversibly.**

#### Relationship between exposure time and thickness



### Concept

#### Circumferential exposure to form uniform thin model



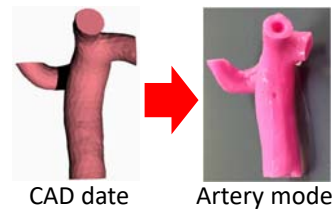
#### Control of thickness of vessel model

Polymerization of resin from outside **gradually**



### Experiments

#### Fabrication of a renal artery model



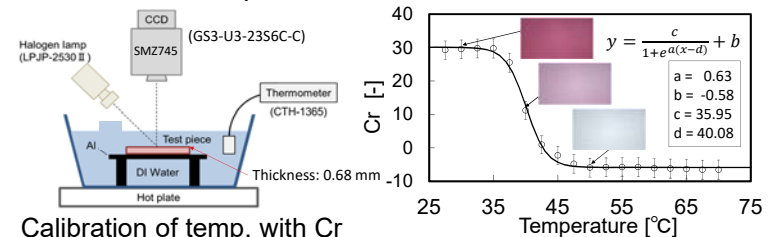
UV exposure time: 120 sec

Measurement result:

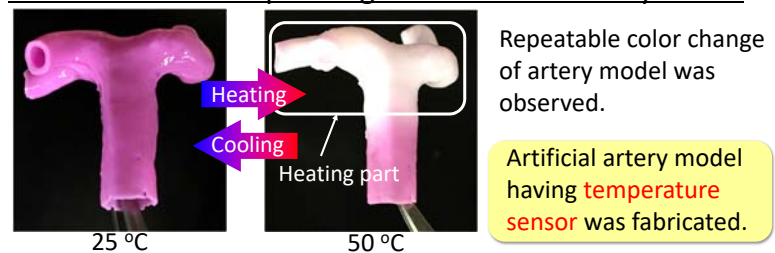
- Average film thickness : **0.73 mm**
- Standard deviation : **0.04 mm**

Renal artery model with **thin and uniform thickness** was fabricated.

#### Calibration of temperature



#### Visualization of temp. change from color of artery model



### Conclusions

- Thickness of artery model was controlled from **0.53 to 1.09 mm** by adjusting UV exposure time (from 90 to 240 seconds).
- Error of temp. measurement was **1 °C** (37.5 degrees to 42.5 °C)

特願2017-195961,丸山央峰, 新井史人, 臓器モデルとその製造方法および管状弾性部材の製造方法, 出願日2017.10.6

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Reference :  
Y. Yokota, K. Hosono, H. Maruyama, F. Arai, Proc. of MHS2017, pp. 109-110, 2017

