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Fundamental Characteristics of Stiffness-Adjustable Soft Actuator Made of Three Functional Polymer Materials Using FDM 3D Printer

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INTRODUCTION & AIM

◆Research Background

Advantage of soft actuator
Shape adaptability
High safety

Disadvantage of soft actuator
Lack of load capacity
Difficulty of complex structure

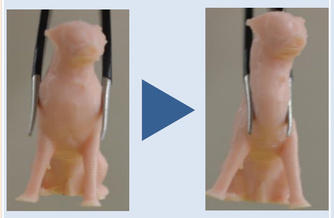
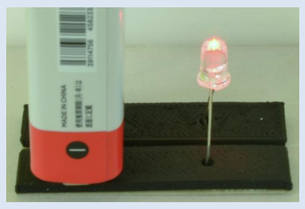
▼ Maintenance ▼ Improvement

The purpose of this study

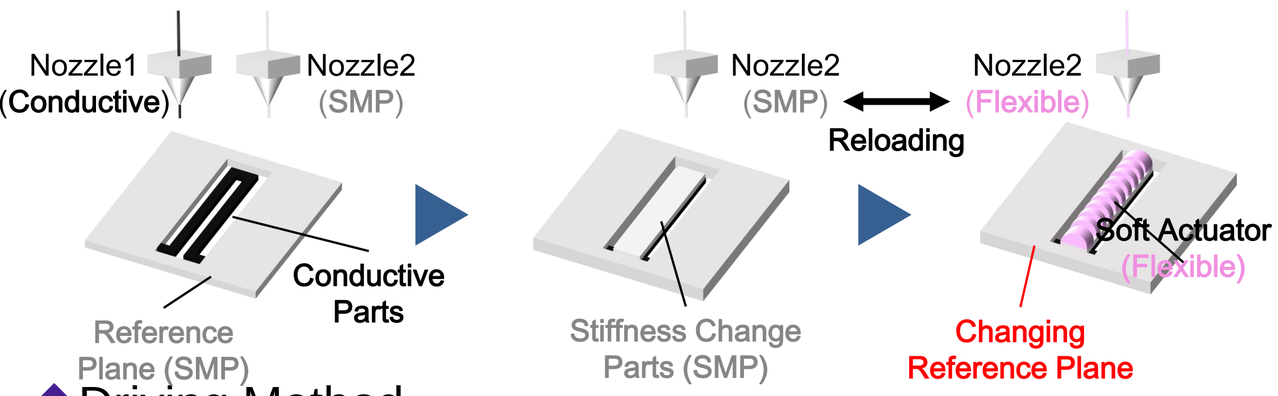
Fabrication of Stiffness-Adjustable Soft Actuator using a normal FDM 3D printer

MATERIALS & STRUCTURE

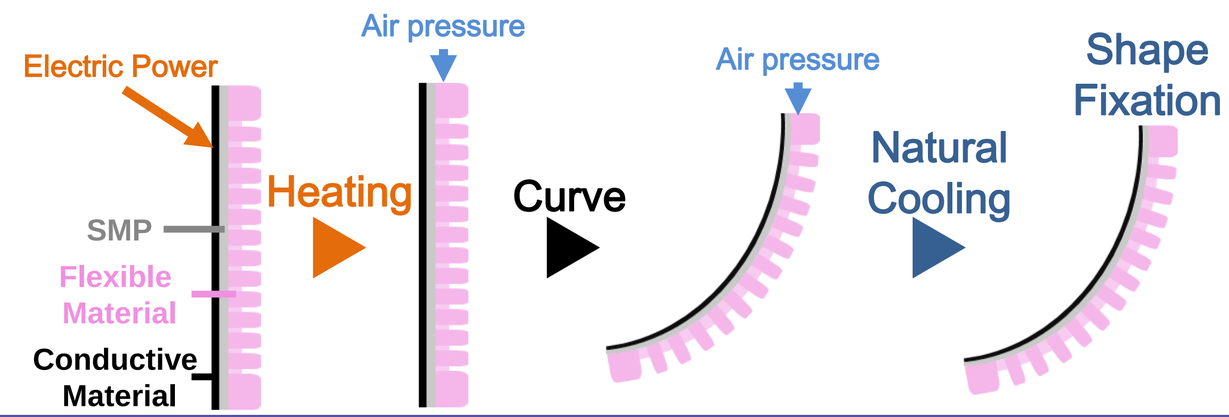
◆Polymer Materials Used In This Study

	Shape Memory Polymer(1)	Flexible Material(2)	Conductive Flexible Material(3)
	Glass (T_g<T) Rubber (T<T_g) Deformity, Shape, Fixation, Recovery		
Feature	Stiffness changes greatly with T_g	Flexibility by vegetable resin	Conductive due to carbon
Property			
Resistance	-	-	3.9 Ω-cm
Durometer	Glass 80D / Rubber 40D	60A	92A

◆Actuator Fabrication Methods



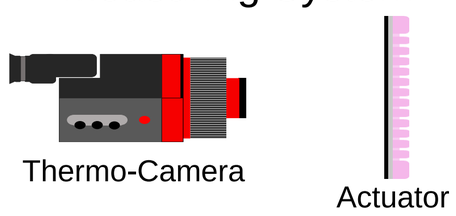
◆Driving Method



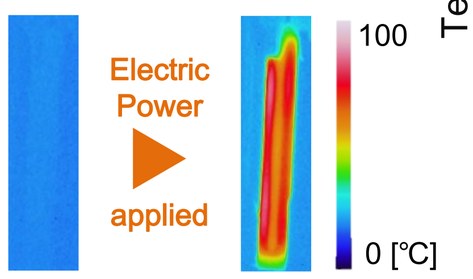
RESULTS & DISCUSSION

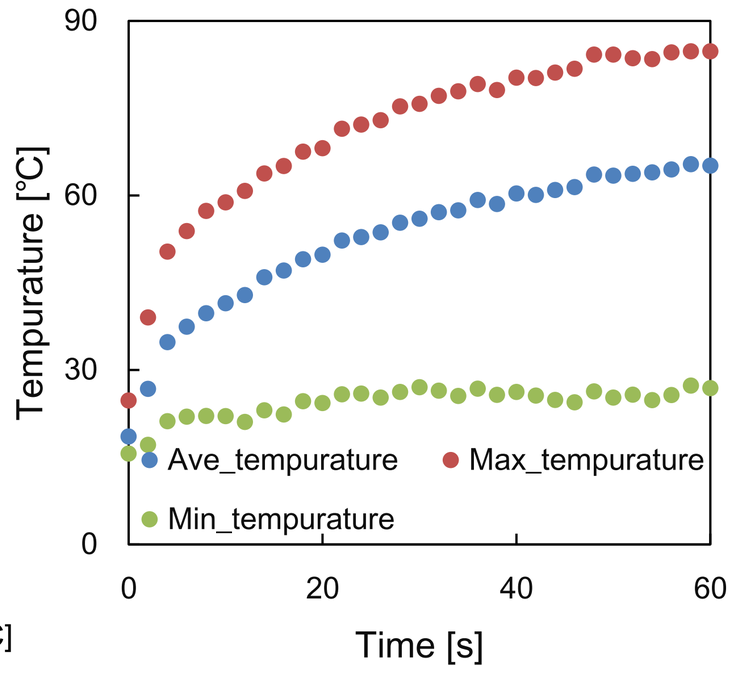
◆Thermal properties of the actuator (90 W)

➢ Measuring System

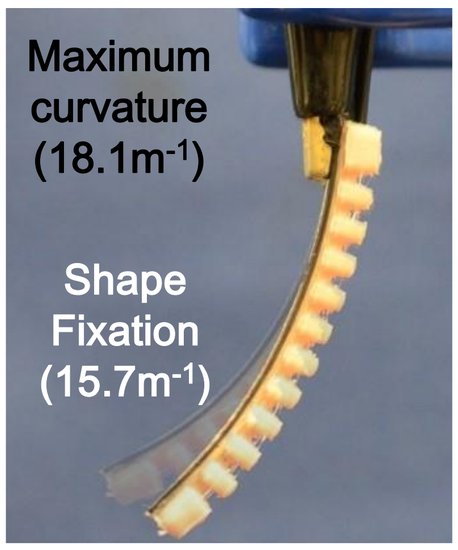


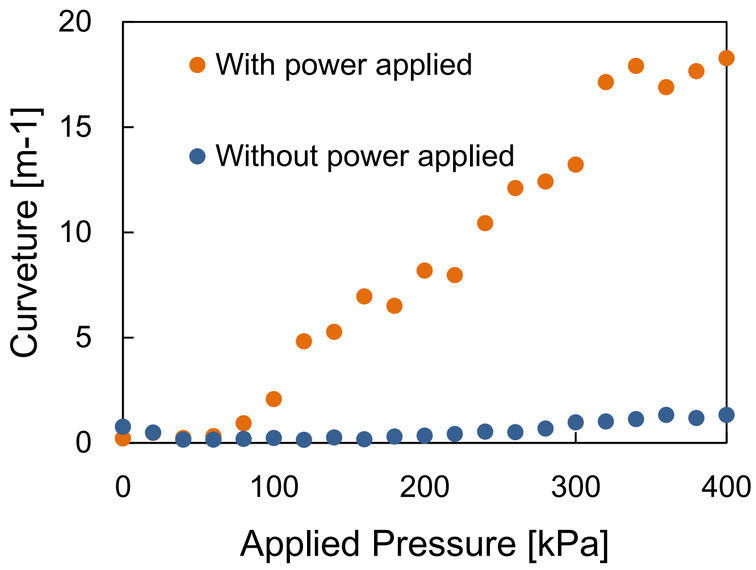
➢ Measuring Results





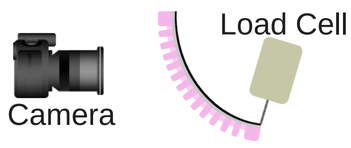
◆Driving characteristics of the actuator





◆Actuator Reaction Force Measurement

➢ Measuring system



➢ Measuring Results

- Rubber state (Electric power applied)
  - **Reaction Force : 125.2 mN**
- Glass state (No Electric power applied)
  - **Reaction Force : 140.5 mN**

CONCLUSION

◆The actuator is created using three different materials at once by 3D printer

◆The developed actuator can be curved at low stiffness condition

◆The actuator's stiffness can be higher with maintaining the deformation state

ACKNOWLEDGMENTS

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