

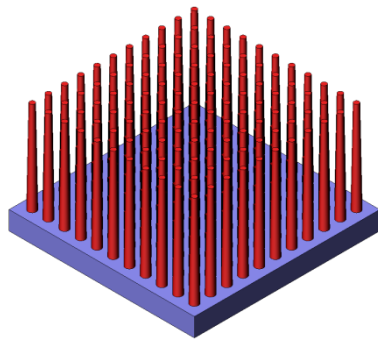
# Nano, micro sensors and actuators for robotics

エレクトロニクス先端融合研究所

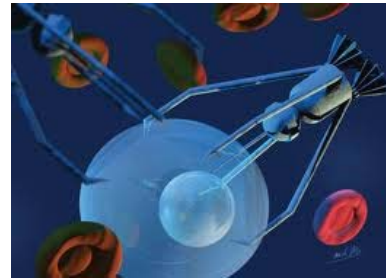
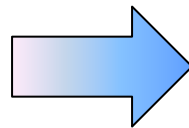
特任助教 テイエティエルコフ スミトリー

## 目的：

The goal of the research is to create the sensors which can detect and process the motion information (speed, acceleration) and actuators for robotics.



Toyohashi probe



Nanorobot



Robot

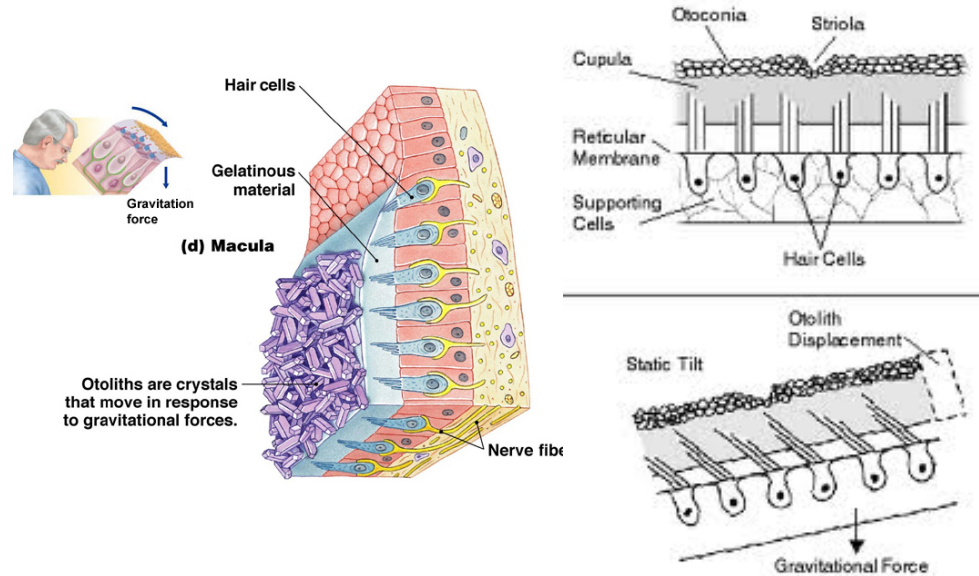
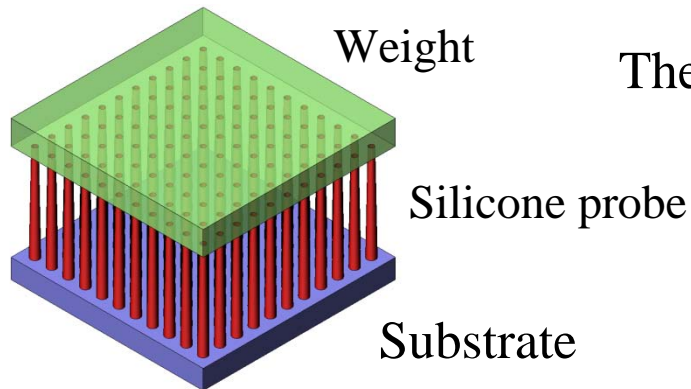
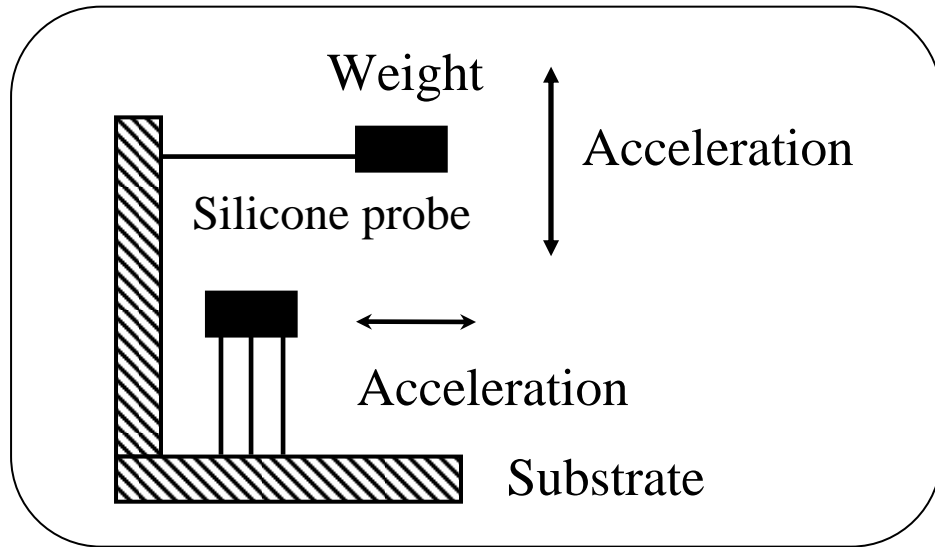
Nano robot



Wearable robot

# 研究概要-1

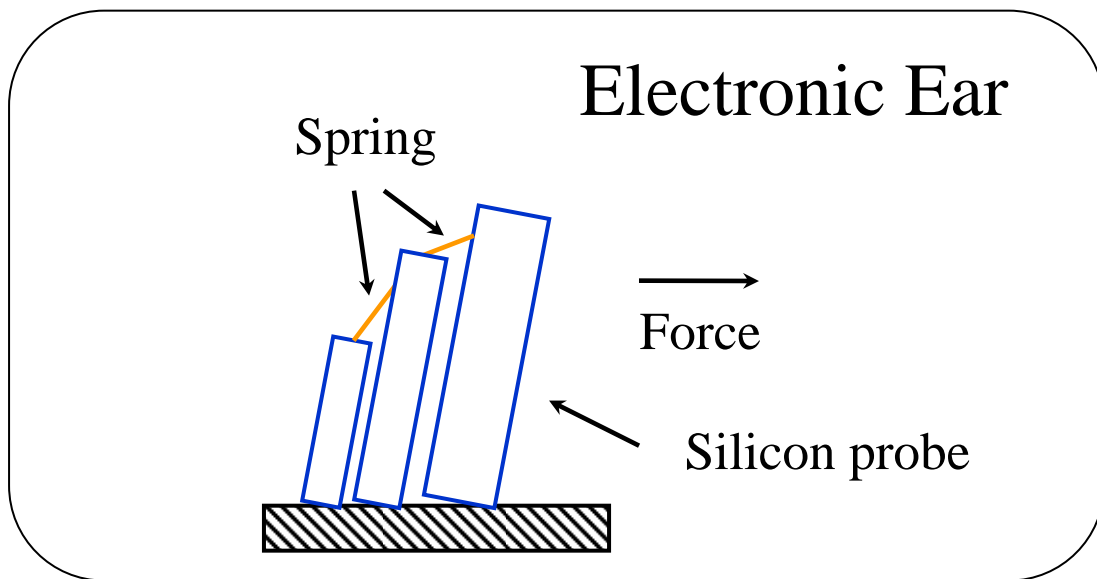
Nano accelerometer:



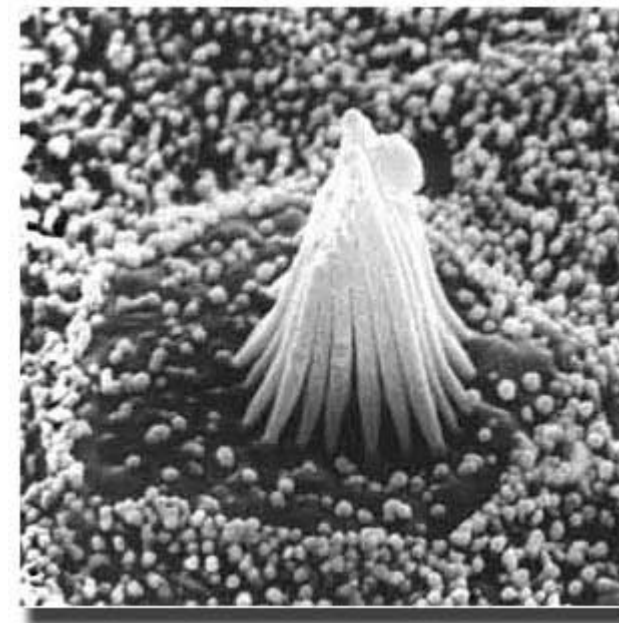
The utricle is organized to detect tilt of the head.

# 研究概要-2

## Nano sensor that detects sound

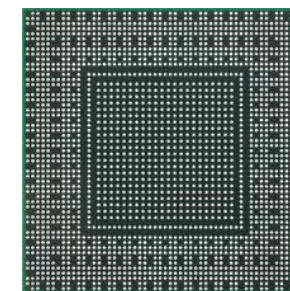
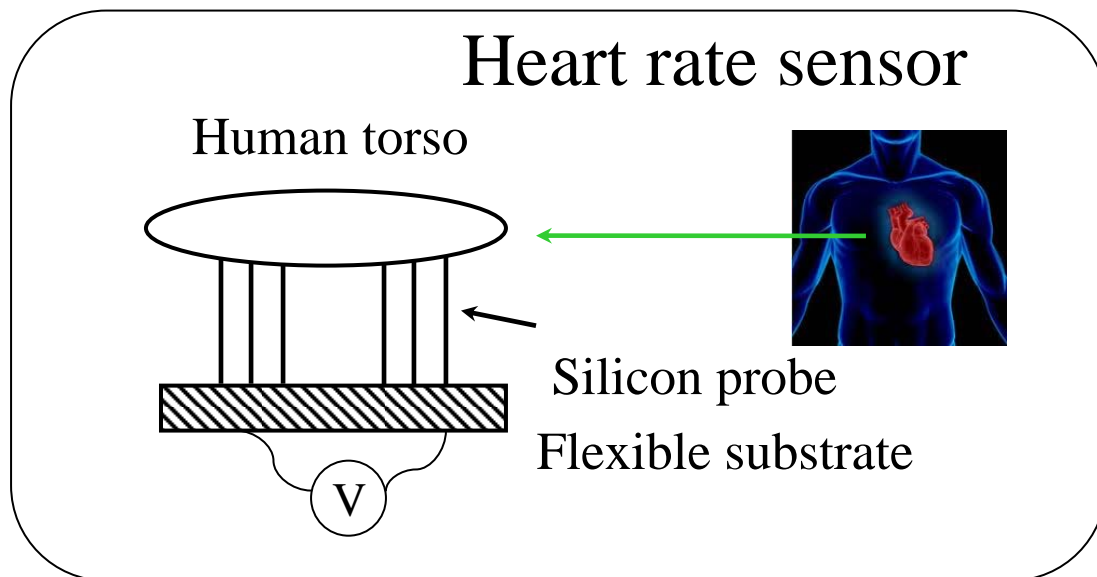


Application of mechanical stimulus to a probe array elicits an electrical response. The spring member regulates the electric current flow.



A scanning electron micrograph of a hair cell's apical surface

## Heart rate sensor

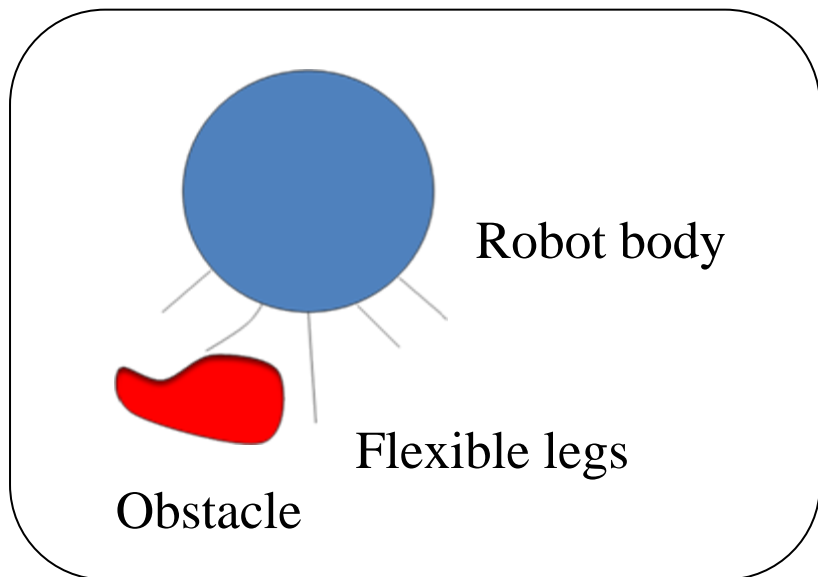


A chip integrating the sensitive units to measure heart rate.

The sensor will detect and amplify the tiny electrical changes on the skin caused by heartbeat (same as ECG).

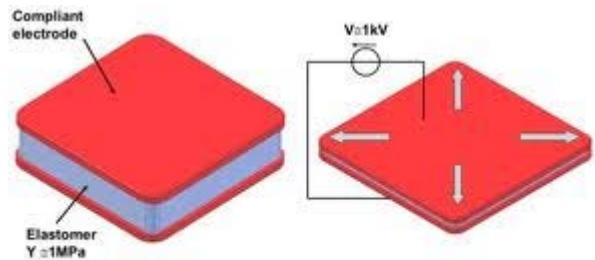
# H22年度：研究目的と成果

## Nano robot

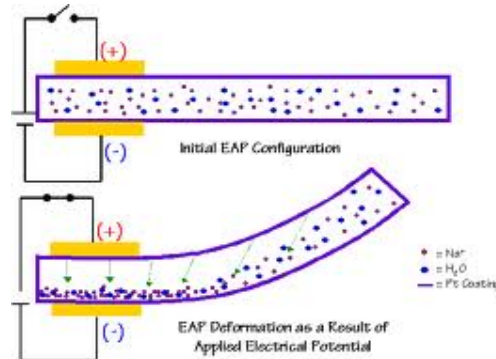


**Nano-robot with flexible legs:** There is the need in robot that can be compact and avoid the obstacles easily. Also there is a big demand for movable nanorobot for delivering the medicine to the cells, care of vessels. The structure of the robot allows to move repelling from the ground.

## Possible candidates for the actuators: electro-active polymer (EAP)

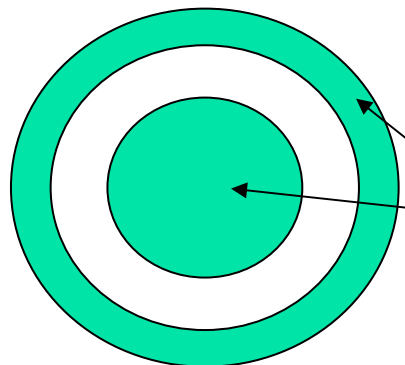


DEAP principle : When a voltage is applied to the electrodes, the electrostatic force squeezes the elastomer dielectric. As elastomers have a Poisson coefficient close to 0.5, the whole structure stretches.



# 研究概要 - 4

## Circular structure

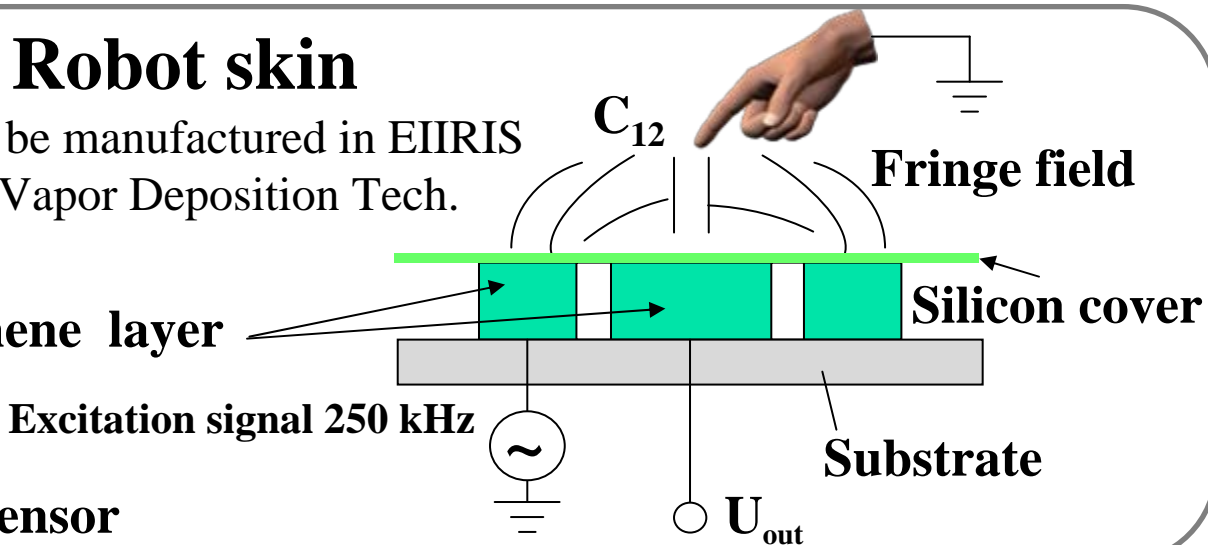


Capacitive graphene touch sensor

Graphene will be manufactured in EIIRIS by Chemical Vapor Deposition Tech.

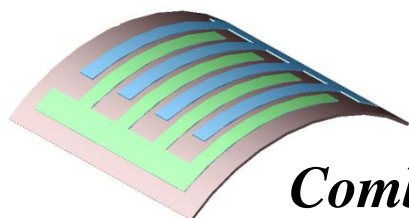
Graphene layer

Excitation signal 250 kHz



## Robot skin

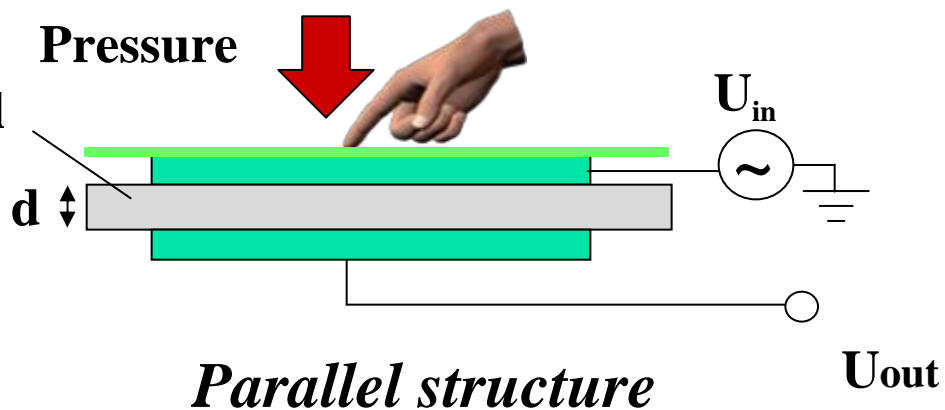
When the finger touches the sensor surface, the distance between the sheets decreases.



Comb structure

Plastic cover protects the graphene from dirt and spillage.

$$C = \frac{Q}{V} = \frac{e_0 A}{d}$$



Parallel structure

# H23年度計画

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- ***Design of the nano-scale accelerometer***
- ***Development of graphene-based touch sensor***