# Swedish-Japanese Joint Symposium

## Continuous health status monitoring of elderly people using flexible skin patch sensors

<table>
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<tr>
<th>Japan</th>
<th>Sweden</th>
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<tr>
<td>Prof. Takao Someya (PL)</td>
<td>Prof. Magnus Berggren (PL)</td>
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<td>Dr. Tryggve Ljung (AbbVie AB)</td>
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<td>(NEC Corporation)</td>
<td>Dr. Björn Garplind (Invisense AB)</td>
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<td>Dr. Göran Gustafsson (RISE Acreo)</td>
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<td>Dr. Michael Peolsson (RISE SICS)</td>
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The arrival of super aged society in Japan

Aging in Japan
Super-aged in 2007
Aging rate
27.3% in 2017
>30% in 2025

Super-aged, Worldwide (Moody’s)
13 countries by 2020
34 countries by 2030

Innovation for healthy longevity society and social system reform are urgently required.

Accessibility to information

A safe and comfortable society will be realized when anyone can monitor biometric information easily, accurately, anytime, and anywhere.
A skin display is an array of micro-LEDs embedded in a thin rubber sheet.

We have developed a skin display with stretchability of 45%.
Fabrication process and mechanical durability

Cyclic stretching tests

A skin display attached to the hand

- A skin display can be nicely fitted on the skin due to its stretchability.
- It exhibits simple graphics with motion including an electrocardiogram waveform measured with skin sensors.
It firmly adheres to the shape of the skin. It is ultrathin and lightweight. A natural skin respiration is realized. There is no sense of fit.

Nanomesh electrodes

Process flow
1. A nanomesh is made of polyvinyl-alcohol (PVA) by an electrospinning method.
2. Gold patterns are formed by vacuum evaporation through a shadow mask.
3. Nanomesh electrodes are laminated onto the skin with dissolving PVA by spraying water.
Skin sensors with nanomesh electrodes

A high level of conformability

Dermatitis evaluate different substrates according to the patch test criteria of the ICDRG.

Biocompatibility test

Three samples were attached to the forearm for a week.

<table>
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<tr>
<th>Substrate</th>
<th>Persons</th>
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<tr>
<td>Silicone (1 mm thick)</td>
<td>4</td>
</tr>
<tr>
<td>Parylene (1 μm thick)</td>
<td>16</td>
</tr>
<tr>
<td>Nanomesh conductors</td>
<td>20</td>
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* International Contact Dermatitis Research Group
Skin sensor to measure electrocardiogram

A wireless module for transmitting data to a smartphone

Real-time monitoring by a smartphone

Nanomesh electrodes attached on the body

A belly band e-textile

Electrocardiogram waveform

A health-monitoring system with skin electronics

Data collections
- Comfortable
- Accurate
- Safe

Cloud
- Al-assisted diagnosis

Feedback
- Natural
- Intuitive
- Safe

Cyberspace

Real space
- Smart phone
- Family
- Nursing stuff

Skin sensors
Patient @ home

Doctor @ hospital

Skin displays #
Patient @ home

A skin sensor system combined with skin display can realize a natural flow from measurement of biometric signals to display of information.

# A waveform stored in memory was exhibited on a skin display in this work.
Overview of this project

Our Vision
Quality of life (QOL) for elderly people will be enhanced by continuously monitoring health conditions.

Physical Sensor
Chemical Sensor
Integration

Sensor patches for elderly people

Challenges
Keep health condition to avoid relying on nursing care and to support self-care.

Our Solution
Botheration with wearable sensors will be eliminated by novel sensor patch, which will be customized to fit with proper life style, custom, and social circumstance in each country.

Challenges
Refocus on effectiveness of elderly house care by early detection of health issues.

Global market

Schedule of the project

- Promote social implementation by technologies to reduce discomfort in wearable devices and realize a healthy life for elderly people
- NEC would like to contribute to improving the practicality of physical sensors developed at the Univ. of Tokyo by providing wireless and packaging technologies.

Development year

- 2016: Wireless healthcare test kit
- 2017: Prototype of the device and evaluate in the lab.
- 2018: Small-scale field test
- 2019+: Improvement of wearing feeling

Not bend
Bendable
Summary

- The new-type wearable sensors with excellent wearing feeling have been developed by using skin electronics.
- A wireless module for skin sensors has been miniaturized and data collection platform has been developed.
- We will conduct a sensing test integrating with Swedish chemical sensors.

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