# Flexible devices using rigid materials

- Device integration method and self-healing metal wire -

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To use energy storage or generator on any surfaces such as curved surface and human body, bendability and stretchability are required. This is a general and important problem to electronic device. Therefore, recently, flexible and/or stretchable device, such as a flexible sensor, display, battery, and solar cell[1], has attracted much attention. To achieve such a flexible device, many researchers have been using organic materials, such as organic light emitting diodes (OLEDs), organic transistors, and organic electrode (e.g. PEDOT:PSS). As compared with metal or semiconductor materials, organic materials might have good properties to mechanical deformation, however the electrical properties are usually bad. Therefore, we focused on achieving flexible devices using "rigid" materials which have good electrical properties. In this presentation, we will introduce two research topics. One is a "stamping transfer method" and the other is "self-healing metal wire".

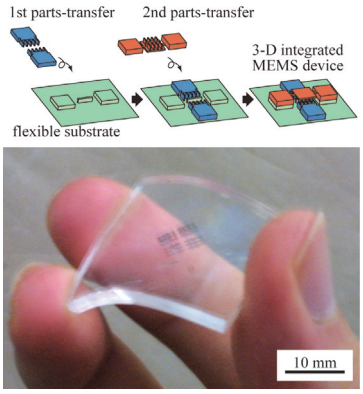


Fig. 1 Flexible electronic device fabricated by stamping transfer method.

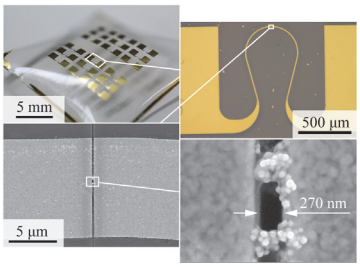


Fig. 2 Self-healing metal wire using an electro field trapping of gold nanoparticles.

The stamping transfer method is an integration method of rigid Micro Electro Mechanical Systems (MEMS) structures with a flexible sheet. The MEMS structures, which are fabricated on the different wafers, are integrated into a single flexible sheet by using lift-off and transfer processes. This is a strong method for assembling 3-D structures[2], integrating heterogeneous materials[3], and fabricating flexible devices[4] (Fig. 1).

We can obtain bendable device by our stamping transfer method. The electric metal wire, however, is easily broken by extensional deformation. Therefore we developed a self-healing metal wire using an electric field trapping of gold nanoparticles[5]. When a voltage is applied to a cracked wire covered with gold nanoparticle dispersion, non-uniform electric field is generated on the crack, and then gold nanoparticles are moved to the crack by dielectrophoresis force. As a result, the crack is healed selectively by the assembled nanoparticles only at the cracked region as shown in Fig. 2. Our stamping transfer method and self-healing metal wire can be widely used for flexible devices, including Lithium-ion batteries, solar cells, and so on.

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