19p-A4-3

Development of a large scale flexible device by printing techniques

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Recently, much interest has been devoted to the development of the printing techniques for fabricating flexible and/or large scale devices such as displays, solar cells, lightings, sensors and so on. These technologies are expected to bring high productivity, green manufacturing (low manufacturing power consumption and less natural resources), and freedom of device design to the fabrication of flexible devices. In order to establish such a technology, many are trying to integrate several printing techniques to give effective device fabrication. However, performance of the devices, which are prepared by conventional printing techniques, is still not enough to the devices for commercial use. Therefore, development of the advanced printing techniques for fabricating flexible devices with both high productivity and high performance is strongly required.

We are trying to develop these advanced printing techniques. Especially, low temperature fabrication process, print process with high resolution, preparation process to improve electric performance of printed pattern and ink materials suitable to these developed fabrication processes. By using these developed advanced printing processes, several kind of flexible device fabrication was demonstrated.

As one of the typical flexible device, a large scale flexible pressure sensor technology is introduced in this talk. There are several kinds of device structure for pressure sensor, such as resistor type, capacitor type and so on. With a purpose of high sensitive flexible pressure sensor, we have examined to develop a ferroelectric type pressure sensor. In order to develop such a high sensitive ferroelectric type pressure sensor, development of the ferroelectric ink is one of the most important subjects. Recently, we have succeeded in finding a promising material to show ferroelectric property on flexible substrate. Some kind of poly-amino acid shows an α-helix structure. Due to its unique structure, it is relatively easy to form its thin film in which its rod-like structure highly ordered. It shows spontaneous polarization without any further treatment, and its thin film device shows ferroelectric property. By using this printed ferroelectric film, ferroelectric pressure sensor was developed. The prepared pressure sensor showed wide range sensitivity (0.5N – 10kN). Furthermore, tilling technique of small piece of flexible sensor devices, we have succeeded in fabrication of large scale flexible pressure sensor. Pressure distribution could be detected by the large-area sensor array sheet. This technology is expected to contribute to the widespread use of sensor network devices such as floor sensors, sheet sensor, bed sensor and so on for security use.