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Professor Heung Cho Ko's research team develops an electronic device that can be automatically transformed into a 3D form (National Research Foundation of Korea)

□ GIST (President Kiseon Kim) School of Materials Science and Engineering Professor Heung Cho Ko's research team has developed a technology that can automatically transform a high-performance planar device into a three-dimensional form.

- It is expected to be widely used in sensors, displays, and bio-robots that require 3D structures because they can be transformed into predesigned shapes and can implement small patterns or complex structures that are difficult to control by hand.

□ In order for wearable devices, bio-robots and others to operate freely as they want, three-dimensional electronic devices such as image sensors, display elements, and energy devices that are capable of omnidirectional communication is important.

- Although research on the process of manufacturing electronic devices directly on 3D structures is active, it has been difficult to keep up with the level of semiconductor processes based on existing planar silicon substrates.

□ On the other hand, if a planar device can be transformed into a three-dimensional form, high-performance, highly integrated planar electronic devices made by using existing semiconductor process technology can be used.

◦ However, in order to transform a very thin flexible electronic device of less than 10 micrometers (μm) into a desired shape, the stability of the device must be supported and a high level of technology for transforming to a three-dimensional shape is required.

□ The research team produced a variable frame that can be automatically transformed into a desired shape based on ABS resin *, which is widely used in home appliances and automobile parts.

> * ABS resin: a synthetic resin with three components of acrylonitrile (A), butadiene (B), and styrene (S), which is used for home appliances and automobile parts due to its excellent formability and plasticity

◦ Complex forms that are difficult to make by hand can be implemented, while mitigating the damage that can be followed when manually modified.

□ First, ABS wire with shear stress (stress acting on the surface of the surface) was printed on the ABS film using 3D printing in which the material content extruded from the nozzle.

◦ In addition, if fluidity is applied by heating above a certain temperature (glass transition ※ temperature), the shear stress is eliminated and the state is induced to a state that can be transformed into a three-dimensional planar form.

> ※ Glass transition: When a liquid is cooled, it hardens rapidly in the temperature range of the material.

□ As a result of mounting the metal electrode and the oxide semiconductor element on the actually-formed variable polymer frame and deforming the shape, the stress on the electrode and the device was significantly reduced and it was confirmed that the drive was stable.

◦ The research, which provided clues to automatically transform high-performance flat-panel electronic devices into three-dimensional ones, was conducted with support from the Ministry of Science and ICT and the National Research Foundation of Korea and was published on November 18, 2019, in the journal *Advanced Functional Materials*.

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