Gwangju Institute of Science and Technology
Official Press Release — https://www.gist.ac.kr

Section of Public Relations	Dongsun Cho Section Chief 062-715-2061	Nayeong Lee Senior Administrator 062-715-2062
Contact Person for this Article	Professor Myung-Han Yoon School of Materials Science and Engineering 062-715-2320	
Release Date	2021.02.08	

Professor Myung-Han Yoon's joint research team develops microfiber-based high-performance conductor technology

□ School of Materials Science and Engineering Professor Myung-Han Yoon's research team from GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) developed a high-performance microfiber-based organic mixed conductor* manufacturing technology together with Professor Jonathan Rivnay from Northwestern University, USA, and Dr. AHN Hyungju's research team from Pohang Accelerator Laboratory.

> * OMIEC (organic mixed conductor): A material that has both ionic conductivity and electrical conductivity in an electrolyte, not as such a simple electrical conductor like metal. Possible to link in-water ion-based bio-electronic signals such as nerve, heart, and muscle signals, and solid-state electric electronic signals based on electrical and hole-based electrical such as metal electrodes and silicon semiconductors. Can be used as an active layer of bio-transplantable electronic devices.

◦ The research team applied strain engineering*, which has been mainly used in commercial semiconductor processes, to single-stranded microfibers to maximize Carrier mobility** and electrical conductivity by aligning polymer microcrystals in one direction.

* Strain engineering: As one of the representative technologies used in silicon-based semiconductor processes, a technology that improves charge mobility and electrical conductivity by controlling the atomic arrangement microstructure by applying the minute stress to the crystalline active layer thin film.

** Carrier mobility: Mobility of electrons and holes with electric charges in a semiconductor

- Organic electrical transistors* have superior capacitance and high electrical switching/amplification characteristics compared to conventional inorganic-based transistors. Hence, it has been in the spotlight as a bio-implantable and skin-attached sensor. Low charge mobility and electrical conductivity, which are chronic problems of organic conductors, have been an obstacle to improving switching and amplification characteristics.

* Organic electrochemical transistor: One of the transistors that drive in an electrolyte. A device that switches and amplifies electrical signals by inducing doping/dedoping of a semiconductor layer through an electrical/electrochemical reaction between the ions present in the electrolyte and the semiconductor layer by the applied gate voltage.

- To improve this problem, the research team aligned the crystal structure in the PEDOT: PSS*-based conductive polymer microfiber in one direction so that a transistor(1500 F cm-1V-1s-1), with more than three times of characteristic evaluation index** compared to the existing devices(490 F cm-1V-1s-1) based on the same material, was implemented.

* PEDOT:PSS (poly(3,4-ethylenedioxythiophene) polystyrene sulfonate): As a representative conductive polymer, it is in the spotlight as an organic electrochemical transistor active layer.

** Figure of merit; ZT: A value for evaluating transistor characteristics. Expressed as the product of charge mobility and volume capacitance (μC*).

- Professor Myung-Han Yoon said, “Through this technology, we have succeeded in manufacturing organic electrochemical transistors, which are recently in the spotlight as bio-implantable electronic devices, in the form of single-stranded fibers and achieving the world's best property evaluation index. In consideration of the high electrical and electrochemical properties of the conductive polymer

fiber material proposed in this study, we expect it to be used as a high-performance implantable electronic device and energy storage device in the future."

- This research was lead by Professor Myung-Han Yoon from GIST, Professor Jonathan Rivnay from Northwestern University, and Dr. Hyungju Ahn from Pohang Accelerator Laboratory and conducted by Young-seok Kim, a PhD student. It was supported by NRF (National Research Foundation of Korea), the Creative Challenge Project, and the Development Project from GIST.

- This paper was published in the online edition of *Advanced Materials*, a highly recognized scientific and technical authority, on February 4, 2021.

GIST
Since 1993