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Research Professor Jaemin Kong's joint research team published in *Nature* on the development of high-performance perovskite solar cells using greenhouse gases

▫ A new organic semiconductor doping technique that can effectively improve the performance of perovskite solar cells, which has been spotlighted as next-generation solar cells by using carbon dioxide, a greenhouse gas, was published in the latest issue of *Nature*, the most prestigious scientific journal.

▫ GIST (Gwangju Institute of Science and Technology) Research Institute of Solar and Sustainable Energies Research Professor Jaemin Kong (graduated from the School of Materials Science and Engineering at GIST in 2013 with a Ph.D., supervising Professor Kwanghee Lee) succeeded in developing high-performance perovskite solar cell production technology using greenhouse gases through a joint research team with Professor Kwanghee Lee, New York University, and Yale University

▫ Organic semiconductors are being used in various fields such as OLEDs, dye-sensitized solar cells, and organic solar cells. Organic semiconductors are also essential for perovskite solar cells, which are spotlighted as a new and renewable energy source to replace silicon solar cells due to their high energy conversion efficiency of 25.5%.

- As a hole transport material in perovskite solar cells, an organic semiconductor called Sprio-OMeTAD, which is a spiro structure, and lithium bismide (LiTFSI) are mixed and used together. Oxygen doping through exposure to air is essential in order for the hole transport material (Spiro-OMeTAD, spiro structure material) to have a hole transport ability above a certain level. This usually requires a process time of several hours to a maximum of one day, which is an obstacle to the commercialization of perovskite solar cells.

- The research team used carbon dioxide, a greenhouse gas, for doping organic semiconductors instead of oxygen. To increase the carbon dioxide doping efficiency, a technique of bubbling carbon dioxide into a solution of a hole transport material (Spiro-OMeTAD, a spiro structure material) and lithium bismide (LiTFSI) was introduced. By blowing carbon dioxide into the solution under ultraviolet light, rapid doping could be induced, and the doping process time could be reduced to 1 minute.

  - The carbon dioxide bubbling technique developed by the research team can not only reduce the specific process time to 1/100 compared to the existing oxygen doping technique. In a short time, the electrical conductivity of the organic semiconductor hole transport material (Spiro-OMeTAD) was raised up to 100 times. Therefore, the results of this study are expected to be used as a technology to advance the commercialization of perovskite solar cells in the future.

  - In addition, since the carbon dioxide used for doping is converted and stored in the form of carbonate, it is expected to be utilized for sustainable carbon source capture and recycling technology at the same time as doping organic semiconductors.

- GIST Dr. Jaemin Kong said, "Through the carbon dioxide doping technique, the conductivity of organic semiconductors used in perovskite could be greatly improved in a short time. What is more interesting is that in the process of doping organic semiconductors, the carbon dioxide used for doping is converted into carbonate and stored. If this process is well utilized, it is expected that it

can be used for greenhouse gas reduction and recycling at the same time as doping organic semiconductors."

- This research was conducted by GIST Research Institute of Solar and Sustainable Energies Research Professor Jaemin Kong as the first author along and was led by School of Materials Science and Engineering Professor Kwanghee Lee with participation from New York University Professor Andre D. Taylor and Yale University researchers with support from the National Research Foundation of Korea's mid-sized research project and intensive research project and was published online on June 2, 2021, in *Nature*, the world's most prestigious scientific journal.

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