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2018.06.11

Profesor Kwang-Hee Lee's research team develops next-generation solar cells with excellent energy conversion efficiency and reproducibility

- GIST (President Seung Hyeon Moon) – A research team led by Professor Kwang-Hee Lee of the School of Materials Science and Engineering has identified the cause of low reproducibility for perovskite solar cells * and has developed a solar cell with excellent energy conversion efficiency and reproducibility.

* Perovskite solar cells: solar cells using perovskite crystalline organic/inorganic composite ionic crystalline materials as photoactive layers

- The organic/inorganic composite perovskite solar cells are attracting attention as next generation solar cells because they can easily be created using a solution process and provide high device performance and an energy conversion efficiency exceeding 20%. However, defects in the organic/inorganic composite perovskite thin film are sensitive to environmental conditions during production, which usually results in poor reproducibility of perovskite solar cell performance and becomes a major obstacle to commercialization.

- Recently, various methods have been reported to minimize the structural defects in perovskite films, but a fundamental solution to the reproducibility problem regarding performance is required.

- The researcher team found that main factor that lowers the photo-charge collection rate * when the density and distribution of structural defects ** that occur when organic/inorganic composite perovskite layers are formed are different. In particular, the results showed for the first time that the relative influence of structural defects is increased when the electric power acting on the photoelectric charge is weak in the solar cell, thereby degrading the performance and reproducibility *** of the device.

* Photo-charge collection rate: efficiency in which electrons and holes formed in the perovskite layer by light are collected by electrodes

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- In addition, the team will work on an electric dipole-based conjugated polymer electrolyte * that can enhance the built-in electric field ** inside the device to solve the low reproducibility problem of perovskite solar cell performance. As a result, the energy conversion efficiency of the device is about 20%, and the performance deviation between the devices is increased, making it possible to dramatically improve the reproducibility of perovskite solar cells.

* Conjugated polymer electrolyte: an organic material consisting of a main chain with a single and a double combination and a side chain with a positive-anion pair attached that is introduced between the electrode and the organic material in the organic electronic device and is used as an interfacial material to lower the resistance of the interface and to assist efficient charge transport

** Built-in electric field is formed in the perovskite layer and collects electrons and holes into the respective electrodes

- Professor Kwang-Hee Lee said, “The results of this research reveal the causes of decreasing efficiency and reproducibility of perovskite solar

cells. This problem was solved by an interfacial engineering method to improve the reproducibility by about two times. These results should be an important turning point in the commercialization of perovskite solar cells.”

- This study was supported by the National Research Foundation of Korea, the Ministry of Science, ICT & Future Planning, the Global Research Laboratory Program, and GIST Research Institute. The research was published on May 7, 2018, in *Energy & Environmental Science*, which is the most prestigious journal in the field of environmental science (IF: 29.518).

