# Highest efficiency of flexible CZTSSe thin-film solar cell achieved

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DGIST announced last week that Dr. Jin-Kyu Kang's research team in Division of Energy Technology achieved 11.4% for the photoelectric conversion efficiency of flexible CZTSSe thin-film solar cell, the highest in the world. This research is expected to contribute to the

development of future solar power technology and the next generation thin-film solar cell industry.

Flexible thin-film solar cells can be applied in various fields such as wearable, building, and automobiles based on the flexible substrate technology. Since CZTSSe thin-film solar cells use low-cost, ecofriendly materials, they are drawing attention and research as the next generation solar power technology throughout the world. However, Flexible CZTSSe's photoelectric conversion efficiency had not exceeded 10% due to technological issues such as the spread of impurities inside the flexible substrate and delamination.

In response, the DGIST research team conducted research and achieved the highest efficiency yet, of 11.4%, which was officially recognized. This achievement is drawing more attention because its mass production is much easier with the use of low-cost, ecofriendly materials such as copper (Cu), zinc (Zn), tin (Sn) than the existing thin-film solar cell (CIGS, CdTe, perovskite), which uses high-cost heavy metal materials such as indium, lead, and cadmium.

One of the biggest achievements of this research is increased efficiency by changing the existing 3-stack structure of CZTSSe thin-film solar cell precursor into a multi-layered structure and by improving voltage characteristics and uniformity. Moreover, it has had a problem with uniformity degradation when a large-area process is applied to thin-film solar cell, but applied process technology in this research improved not only efficiency but also uniformity.

Dr. Kee-Jeong Yang who led the development of the process technology said "Our research achievement has presented ways to secure the uniformity of a large-area process which can cause issues in commercialization. We will be able to advance the commercialization of next generation solar cell which is applicable in various fields such as

building outer walls." Moreover, Senior Researcher Jin-Kyu Kang, the research project manager, said "As there is growing interest towards the environment and resources are used unlimitedly these days, it is a very meaningful achievement that we have developed a thin-film solar cell using widely available, ecofriendly materials. We plan to lead the future solar cell technology using widely available materials and contribute to the development of thin-film solar cell industry."

**More information:** Kee-Jeong Yang et al, Flexible Cu2ZnSn(S,Se)4 solar cells with over 10% efficiency and methods of enlarging the cell area, *Nature Communications* (2019). DOI: 10.1038/s41467-019-10890-x

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