

Themed issue on “next-generation solar cells”

Zhanhua Wei¹ ✉ and Liang Li² ✉

¹ Institute of Luminescent Materials and Information Displays, College of Materials Science and Engineering, Huaqiao University, Xiamen 361021, China

² Jiangsu Key Laboratory of Thin Films, Center for Energy Conversion Materials & Physics (CECMP), School of Physical Science and Technology, Soochow University, Suzhou 215006, China

With the expansion of population, the depletion of fossil fuels, and the increase in environmental pollution yearly, renewable clean energy has become an urgent demand for today's society. Solar cells are devices that convert sunlight into electricity. In this technology, power conversion efficiency (PCE) and operational stability (OS) are the most critical indicators of system performance. Currently, silicon-based solar cells have become one of the world's most important renewable energy sources. These cells are commonly regarded as first-generation solar cells; amorphous Si, CdTe, and CIGS thin-film solar cells are considered second-generation solar cells. The development of next-generation solar cells has been the objective of researchers to increase PCE and OS at a reduced cost.

In this special issue, perovskite solar cells (PSCs), organic solar cells (OSCs), and quantum dot solar cells (QDSCs) are of particular interest. These types of solar cells are also referred to as emerging solar

cells, where perovskites, organic heterojunctions, and quantum dots serve as absorbing layers. Tremendous efforts have been made to successfully develop these types of solar cells. In recent years, the advances in chemical synthesis, device engineering (optimization of the charge carrier transporting layer, doping engineering, interface engineering, etc.), and a deep understanding of the light-to-electricity conversion mechanism have resulted in PCEs of 26.1%, 19.2%, and 18.1% for PSCs, OSCs, and QDSCs, respectively, demonstrating that the performance of next-generation solar cells is close to that of the highly efficient and stable inorganic silicon solar cells^[1].

To implement highly efficient and stable next-generation solar cells, reliable quantitative data and multidisciplinary research collaboration (i.e., theory, simulation, and experiments) are essential. Even though device performance has significantly increased, the following challenges in “next-generation solar cells” need to be addressed:

Next-generation solar cells	Challenges
Perovskite solar cells	How can lead leakage be prevented and perovskite stability increased under harsh conditions (i.e., 85°C, 85% RH) for up to 10 years?
Organic solar cells	How can photostable nonfullerene derivatives (electron acceptors) and conjugated polymers (electron donors) be designed with a low energy bandgap and enhanced optoelectronic properties?
Quantum dot solar cells	How can nontoxic or less toxic quantum dots with an efficiency similar to cadmium or lead-based quantum dot solar cells be synthesized?

Energy Materials and Devices is an interdisciplinary journal covering the cutting-edge field of energy materials and devices, including (but not limited to) batteries, solar cells, fuel cells, supercapacitors, flow batteries, energy harvesting devices, battery recycling, safety assessment, carbon capture and storage, and structure characterization. The current issue includes the most recent research and review articles on PSCs, OSCs, and QDSCs. We hope the papers in this special issue will stimulate new research and development in “next-generation solar cells” and bring them closer to industrial applications. The editorial team

would like to thank those who contributed to this special issue for (i) sharing their excellent experimental results, (ii) summarizing and reviewing specific topics, and (iii) helping the editorial team to facilitate the review process and provide valuable suggestions. Without their great support, this issue would not have been successful.

Reference

- [1] Best Research-Cell efficiency chart. <https://www.nrel.gov/pv/cell-efficiency.html> (accessed: August 2023).

✉ Address correspondence to Zhanhua Wei, weizhanhua@hqu.edu.cn; Liang Li, lli@suda.edu.cn