

## **Doubling the Power Conversion Efficiency of Single-junction Solar Cells**

Zhigang Li<sup>1</sup>, Bingqing Wei<sup>2\*</sup>

<sup>1</sup>*School of Materials Science and Engineering, Taizhou University, Taizhou 318000, China*

<sup>2</sup>*Department of Mechanical Engineering, University of Delaware, Newark, DE 19716, USA*

\*Presenter's email: [weib@udel.edu](mailto:weib@udel.edu)

### **ABSTRACT**

Solar cells play a pivotal role in addressing some of the most pressing challenges facing our planet today. As a clean, renewable energy source, solar cells significantly reduce our dependence on fossil fuels, mitigate climate change, and curb environmental degradation. Harnessing the power of sunlight, solar cells convert sunlight into electricity, offering a sustainable and environmentally friendly alternative to conventional energy sources. The widespread adoption of solar technology promises to achieve energy independence for nations, reduce greenhouse gas emissions, and promote a more sustainable and resilient energy infrastructure. Additionally, solar power can empower communities in remote or off-grid areas by providing access to electricity when traditional power sources are impractical or unavailable. The importance of solar cells lies not only in their capacity to generate clean energy but also in their role as catalysts for a more sustainable and equitable future.

Improving the power conversion efficiency (PCE) of solar cells is critical for advancing renewable electricity generation and achieving a sustainable energy infrastructure. Silicon solar cells, the most widely deployed photovoltaic technology, are fundamentally constrained by heat-dissipation losses, resulting in a Shockley-Queisser efficiency limit below 33% for single-junction devices. How to further improve the PCE to the next level is a fundamental and practical challenge. To address this challenge, this talk will discuss emerging strategies to boost silicon solar cell performance beyond conventional limits through temperature regulation, enhanced light penetration, and carrier density and mobility optimization. Together, these advances highlight the transformative potential of photothermal regulation in advancing next-generation solar energy conversion technologies.