# Perovskite solar cell-hybrid devices: Thermoelectrically, electrochemically, and piezoelectrically connected power packs

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**ABSTRACT**

Findings and reports in the field of perovskite solar cells (PSCs) have been phenomenal and embrace diverse perspectives such as technical issues, yielding, marketing, and environmental concerns. Bottlenecks in the structure, manufacturing, and operation of PSCs have been frequently addressed; the use of various means including crystallography and kinetics studies, simulation, material, solution, and surface/interface engineering, as well as their outcomes, have yielded certified efficiency of 23.7%. However, the short lifecycle, large waste-to-harvest ratio, functional failure during bending and in the dark mode, environmental and stability issues, and lack of power storage hinder their commercial viability. As a remedy, PSCs can be teamed up with one or multiple mechanical or thermal energy-harvesting or electrochemical power storage devices that can fully or partially overcome these nonidealities. Here, the means of integrating different devices with PSCs to form hybrid packs are discussed. The factors contributing toward the efficiency and mechanical robustness of PSCs and their hybrid devices upon integration are investigated. As an essential bridging component, carbon electrodes are also considered.

**KEYWORDS:** Perovskite solar cells (PSCs); thermoelectrically; electrochemically; piezoelectrically

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