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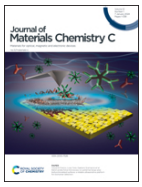

From the journal:
Journal of Materials Chemistry C

Enhanced nanogenerator by embedding lead-free double perovskite $Cs_2AgBiBr_6$ in polymer matrix for hybrid energy harvesting †

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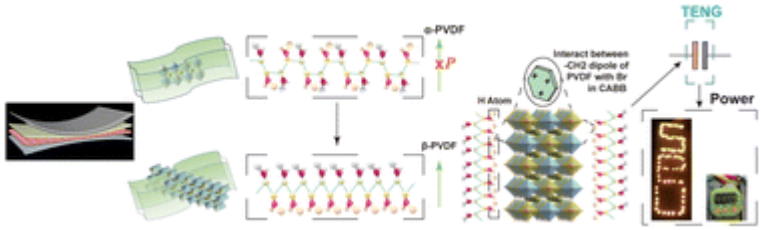
Abstract

Mechanical energy harvesters fabricated with halide perovskites display excellent electrical output because of their prominent permittivity. An all-inorganic lead-free double perovskite, $Cs_2AgBiBr_6$ (CABB), with competitive performance, excellent environmental stability and non-toxicity can break the confines of practical unavailability. CABB microcrystals, which are effective nucleating agents and dielectric fillers, are embedded into a polyvinylidene-fluoride (PVDF)-matrix as efficient electron-acceptors to induce electro-active PVDF β-phase formation and enhance the composite dielectric constant, which contributes to notable hybrid electric outputs. CABB–PVDF hybrid nanogenerators with the optimal CABB concentration of 20 wt% possess triboelectric and piezoelectric effects, with a nanogenerator with a 1.2 cm × 1.2 cm effective contact area and 70 μm film thickness exhibiting a unique response with an open-circuit voltage of 126 V and a short-current density of 4.67 mA m^{-2} under a 0.5 Hz mechanical frequency and 4 cm s^{-1} motion speed. An identical device achieves the highest output power density of 0.39 W m^{-2} at 8 Hz and 0.64 m s^{-1}, which could light up at least 86 commercial LEDs using a 1 μF capacitor and power small electronic devices such as a timer using 22 μF. The corresponding force sensing is achieved with a different distribution of external forces using a 10 wt%

CABB–PVDF composite film. This functional composite maintains its stability and charge retention capacity for effective application in various environmental conditions.



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Article information

https://doi.org/10.1039/D3TC03314G

Article type
Paper

Submitted
12 Sep 2023

Accepted
25 Nov 2023

First published
27 Nov 2023

Citation
J. Mater. Chem. C, 2024, **12**, 207-220

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