Molecular engineering for sustainability

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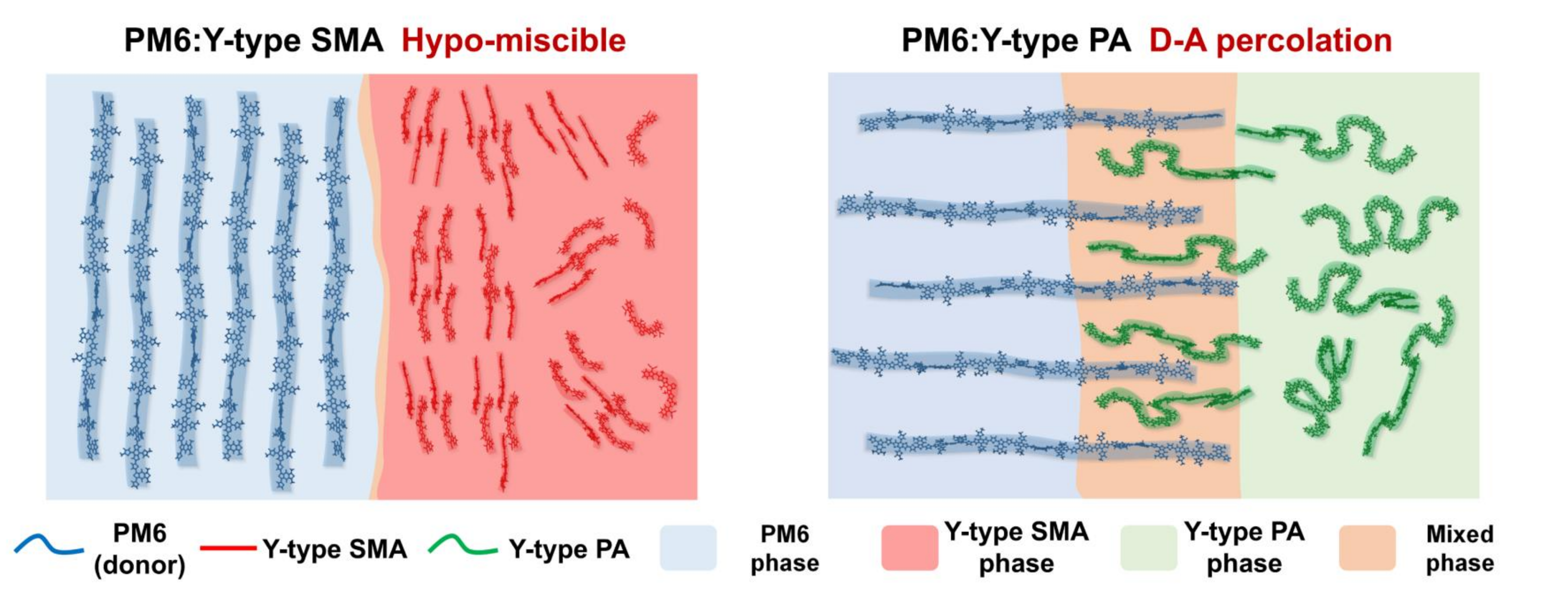
Research scope

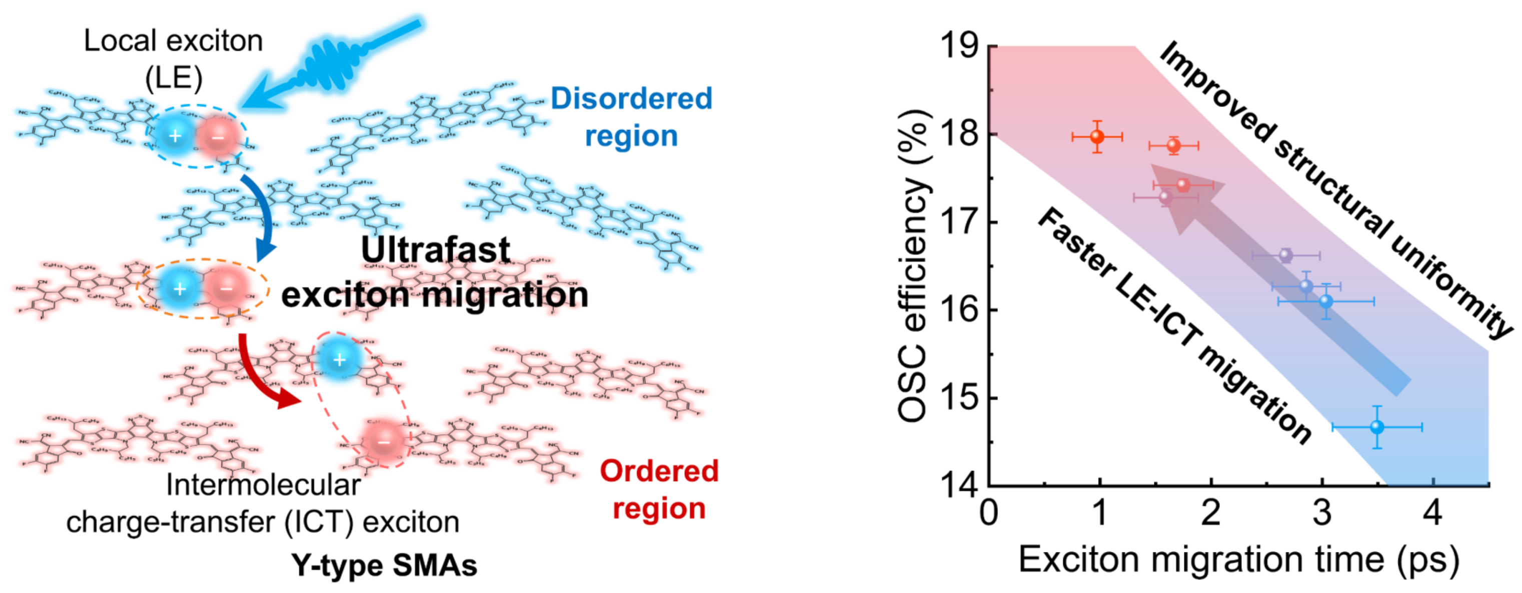
Traditional optoelectronics and photonics are based on rigid, energy-intensive inorganic semiconductors, limiting their flexibility and suitability for wearable, adaptable, and sustainable technologies. Our multidisciplinary research team—spanning chemistry, physics, engineering, and materials science—is pioneering a new generation of soft organic optoelectronic and photonic materials that are flexible, lightweight, and cost-effective. By integrating expertise across these fields, we develop materials that enable high-efficiency solar energy harvesting and storage, advanced biomedical imaging, quantum information processing, and functional textiles with radiation-control properties to enhance energy efficiency and promote sustainability.

Flexible solar cells & photodetectors

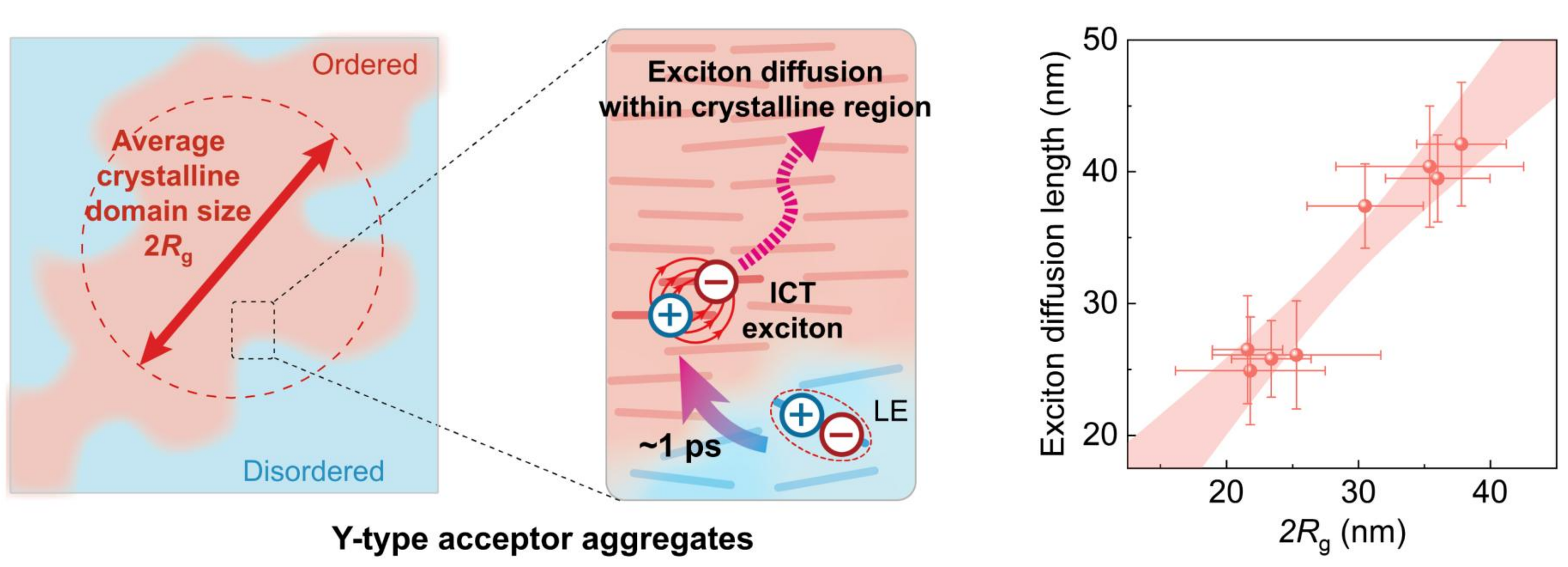
Organic optoelectronic devices hold great promise for solar energy and wearable applications, yet the fundamental mechanisms of charge photogeneration are not fully understood. We employ ultrafast optical and structural imaging techniques to unravel these processes, providing insights that guide the development of high-performance devices, now achieving over 20% solar PV efficiency.



Nat. Commun. **15, 1212 (2024)**



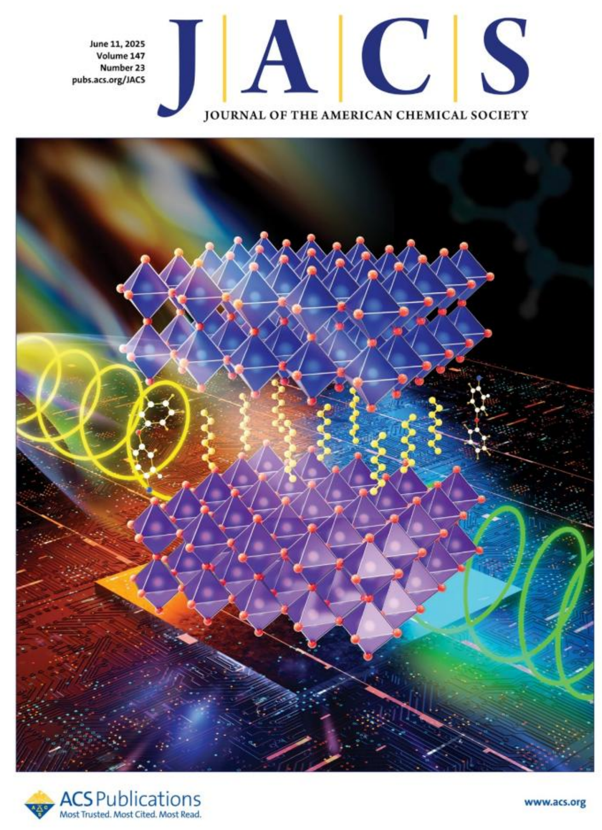
Energy Environ. Sci. **17, 8776 (2024)**

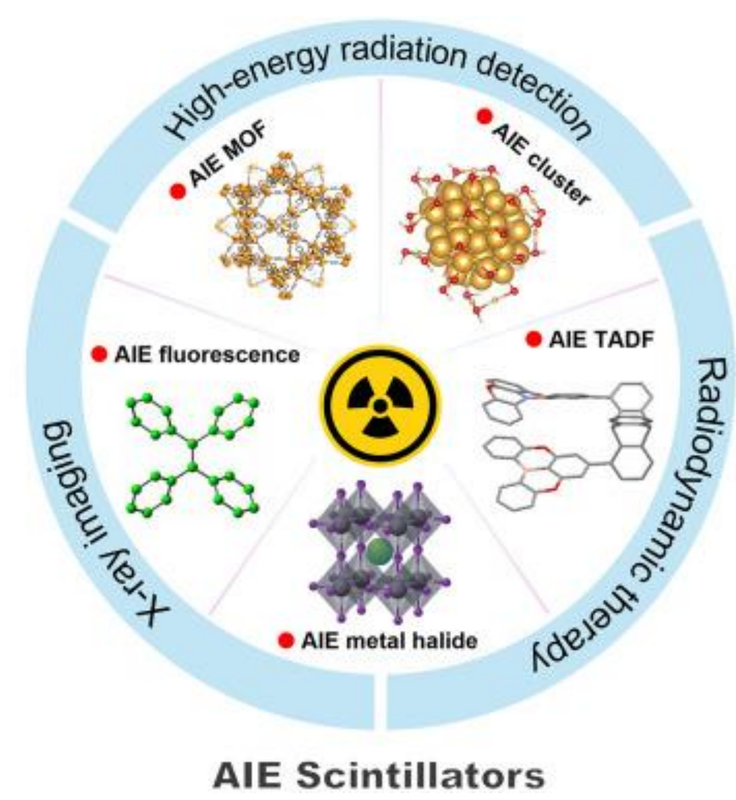


Adv. Funct. Mater. **e17322 (2025)**

Organic & hybrid light emitters

We design and synthesize emitters with tailored properties including near-unity photoluminescence quantum yield, negligible self-reabsorption, outstanding X-ray scintillation and tunable circularly polarized emission. These low-cost luminescent materials can be optimized for specific needs, making them highly promising for next-generation displays, data communications, and bioimaging applications.

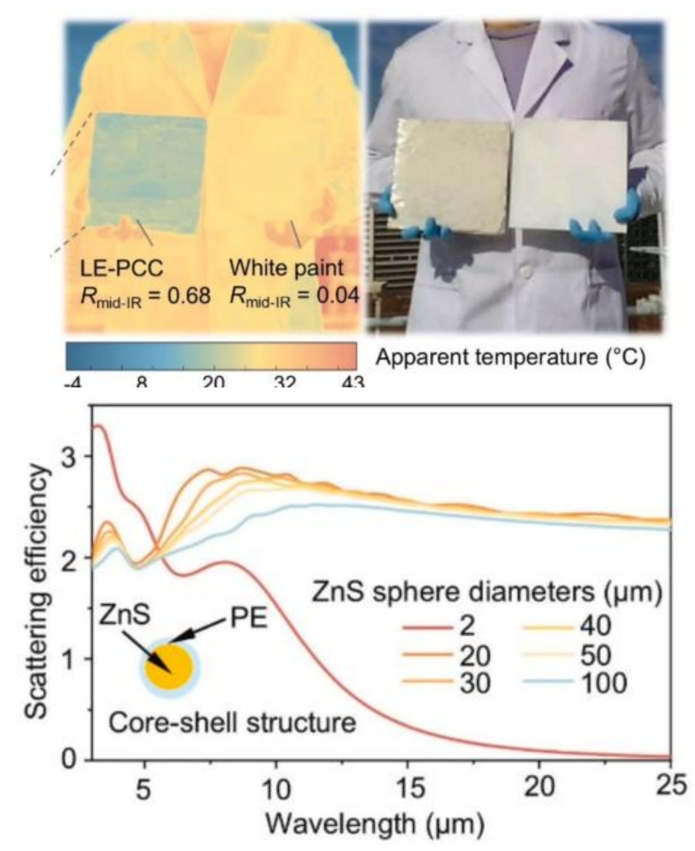




J. Am. Chem. Soc. **147, 19902 (2025)** ***Chem*****, 102534 (2025)**

Scalable materials for thermoregulation

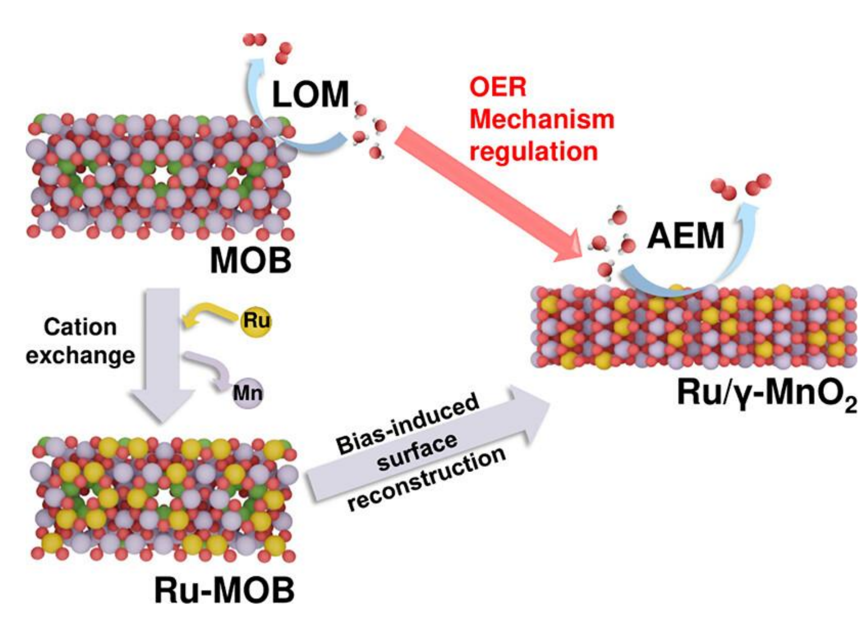
We develop scalable polymer-based technologies for advanced IR radiation control, enabling energy-efficient personal and building thermoregulation to reduce HVAC energy consumption and mitigate risks of hypo- and hyperthermia caused by extreme temperatures due to climate change.



Mater. Today**. 91, 244–252 (2025)**

Nanoscale materials for catalyst

We investigate and engineer excited-state properties in nanoscale materials to drive catalytic reactions, including water splitting for efficient and stable green hydrogen production, and CO_2 reduction for mitigating climate change.



ACS Energy Lett. **10, 2641 (2025)**

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