

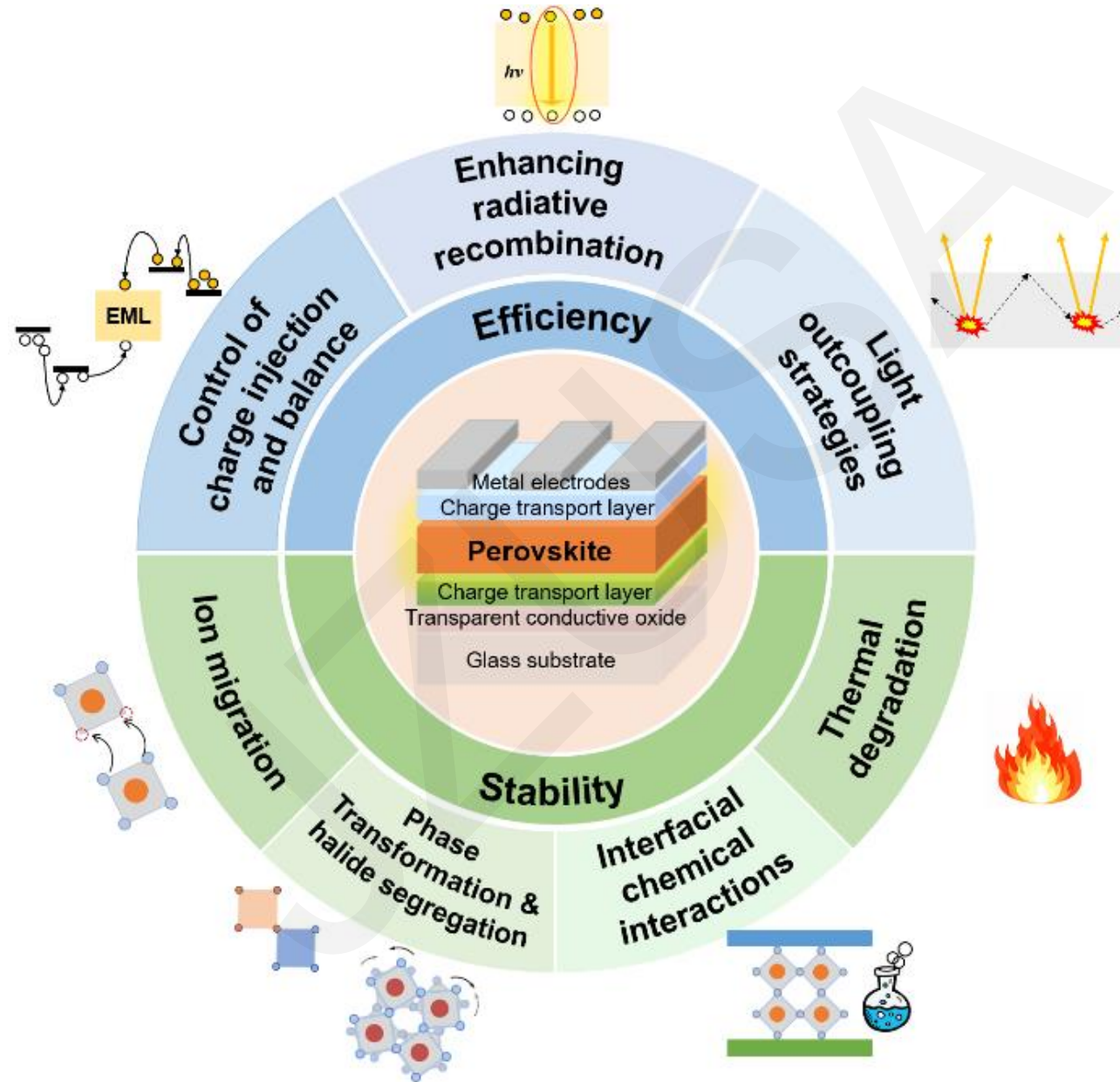
Efficient and stable perovskite light-emitting diodes

Zhuoyue GU, Suhui ZHANG, Wentao XIONG, Baodan ZHAO, Dawei DI

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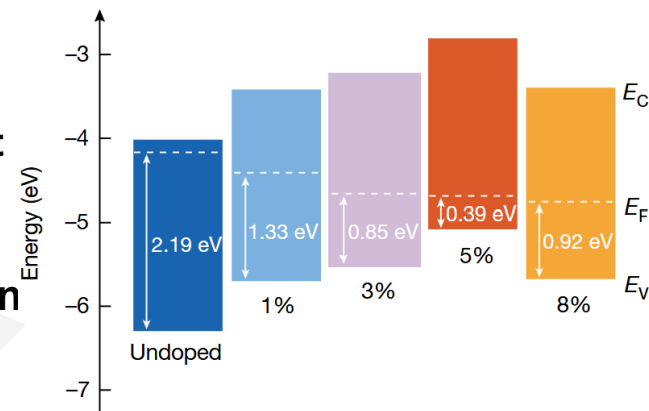
<https://doi.org/10.1631/jzus.A2500056>

Efficient and stable perovskite light-emitting diodes



Control of charge injection and transport

- Optimizing energy level alignment
- Balancing the charge transport
- Enhancing radiative recombination

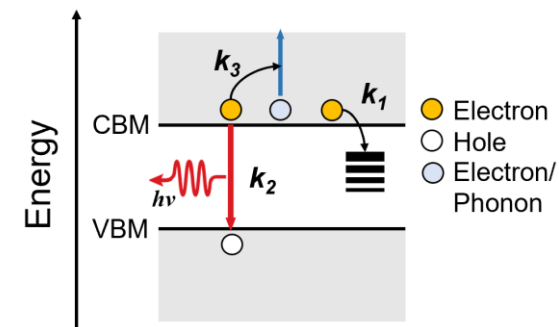


Nature **633**, 344 (2024)

Creating highly efficient PeLEDs

Enhancing radiative recombination

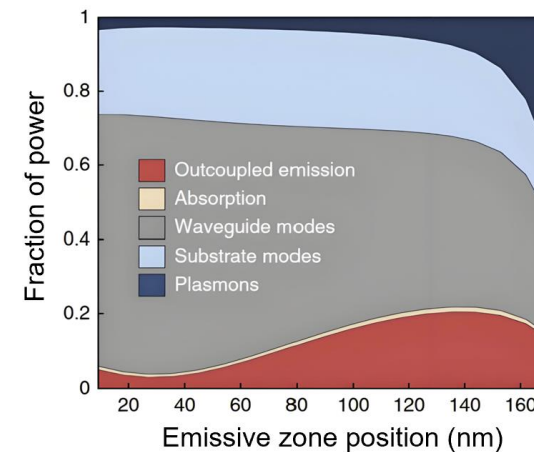
- Defect passivation
- Interfacial modification
- Dimensionality regulation



Nano. Lett. **17**, 3701 (2017)

Light outcoupling strategies

- Modulation of intrinsic optical properties
- Management of external optical structures

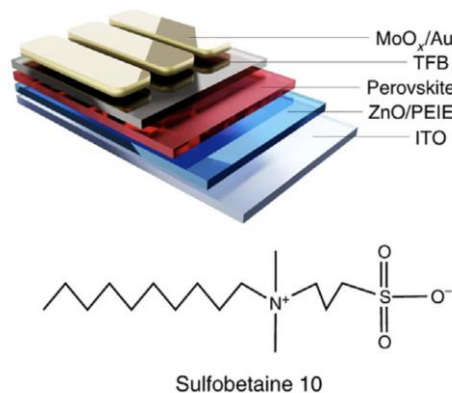


Nat. Photonics **12**, 783 (2018)

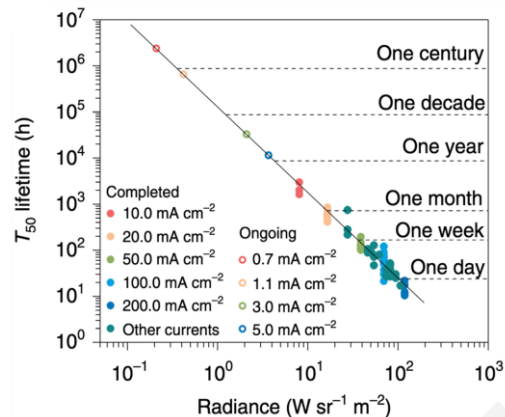
Achieving highly stable PeLEDs

State-of-the-art devices

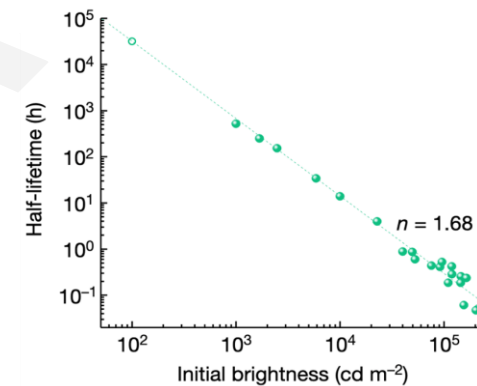
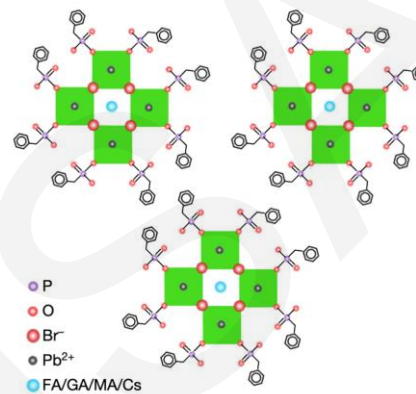
• NIR PeLEDs



Nat. Photonics **16**, 637 (2022)

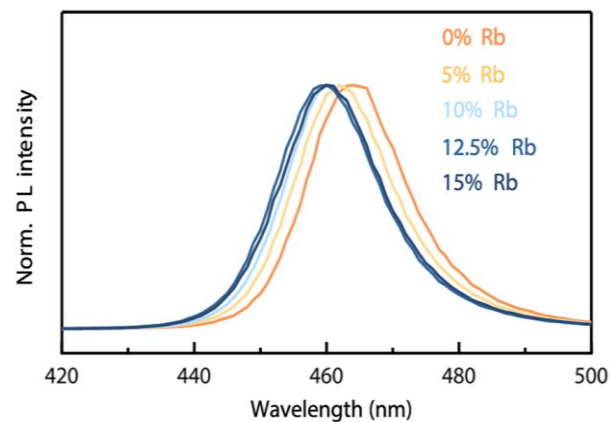


• Green PeLEDs



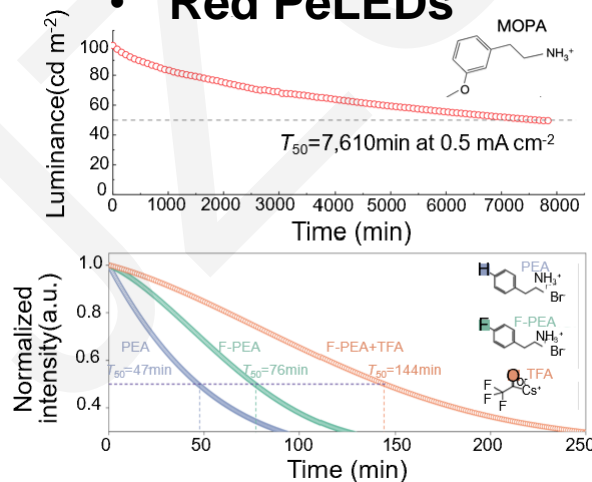
Nature **611**, 688 (2022)

• Blue PeLEDs



Sci. Adv. **10**, eado5645 (2024)

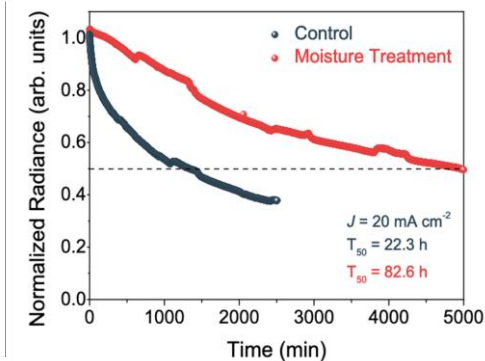
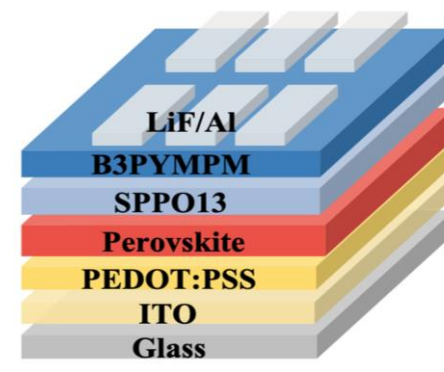
• Red PeLEDs



Nature **631**, 73 (2024)

Nat. Nanotechnol. **20**, 507 (2025)

• Lead-free PeLEDs

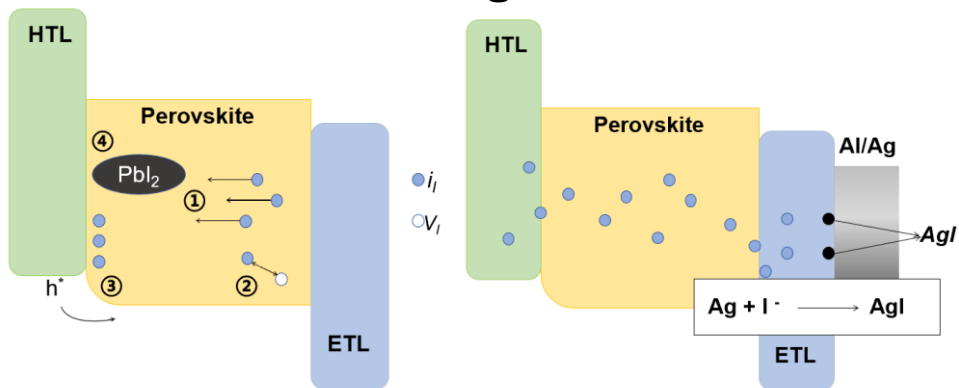


Nat. Commun. **15**, 9913 (2024)

Achieving highly stable PeLEDs

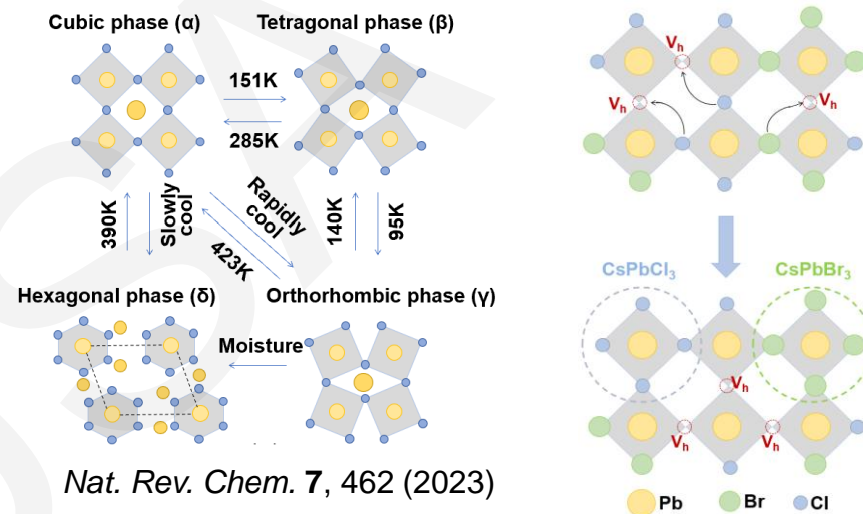
Key mechanisms of degradation in PeLEDs

• Ion migration



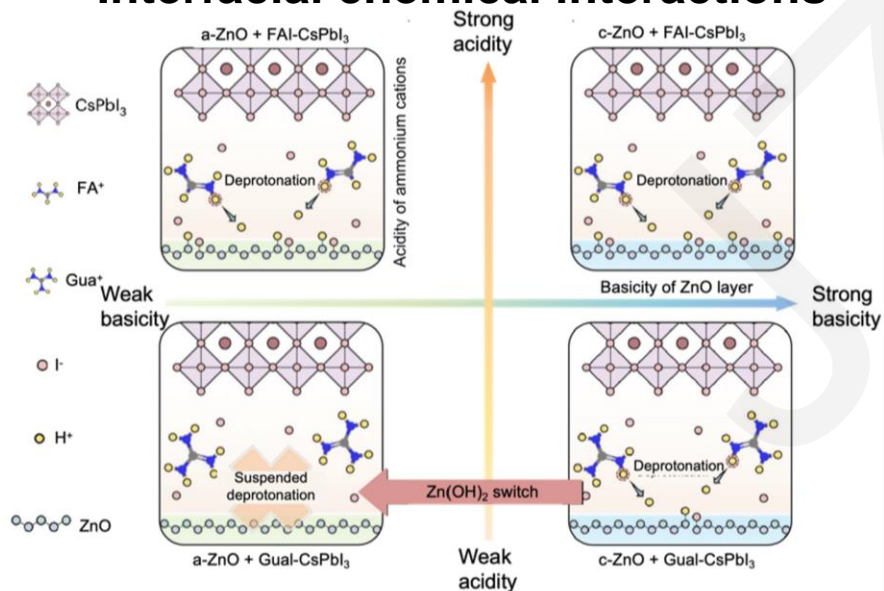
JPhys. Mater. **3**, 012002 (2020)

• Phase transformation and halide segregation



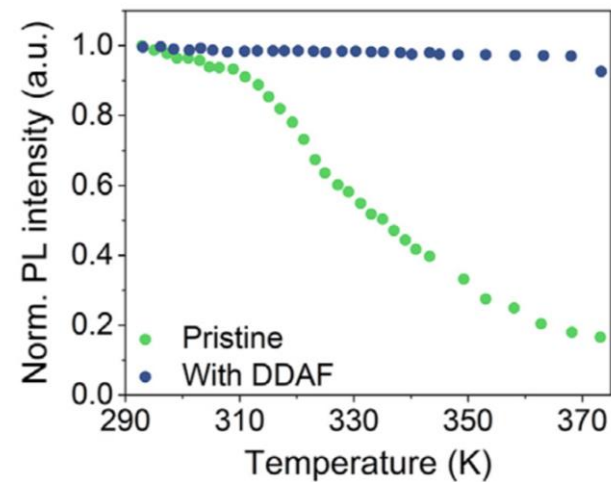
Nat. Rev. Chem. **7**, 462 (2023)

• Interfacial chemical interactions



Nat. Photonics **18**, 325 (2024)

• Thermal degradation



Nat. Photonics **15**, 379 (2021)

Summary & Outlook

Recent advances in the efficiency and operational stability of PeLEDs suggest that PeLEDs are transitioning from a laboratory curiosity to a commercially viable technology. Despite encouraging breakthroughs in PeLEDs, several issues must still be overcome to unlock the full potential of PeLEDs.

- Challenges ahead :**
- High-performance standard blue PeLEDs
 - High-brightness operation
 - Long-term operational stability
 - Lead-free PeLEDs
 - Downscaling (*Nature* **640**, 62 (2025))