

Fabrication and characterization of lanthanide-doped perovskite solar cells

Ryushi Nakamura ¹, Atsushi Suzuki ¹, Takeo Oku ¹, Tomoharu Tachikawa ², Sakiko Fukunishi ²

The University of Shiga Prefecture 1
Osaka Gas Chemicals Co., Ltd 2

THE UNIVERSITY OF
SHIGA PREFECTURE

OSAKA GAS CHEMICALS

INTRODUCTION & AIM

Perovskite solar cells have been expected to become an alternative to silicon solar cells

Challenges

The formation of PbI_2 during long-term storage
The decrease in FF due to defects in the perovskite layer

Characteristics of rare earth elements

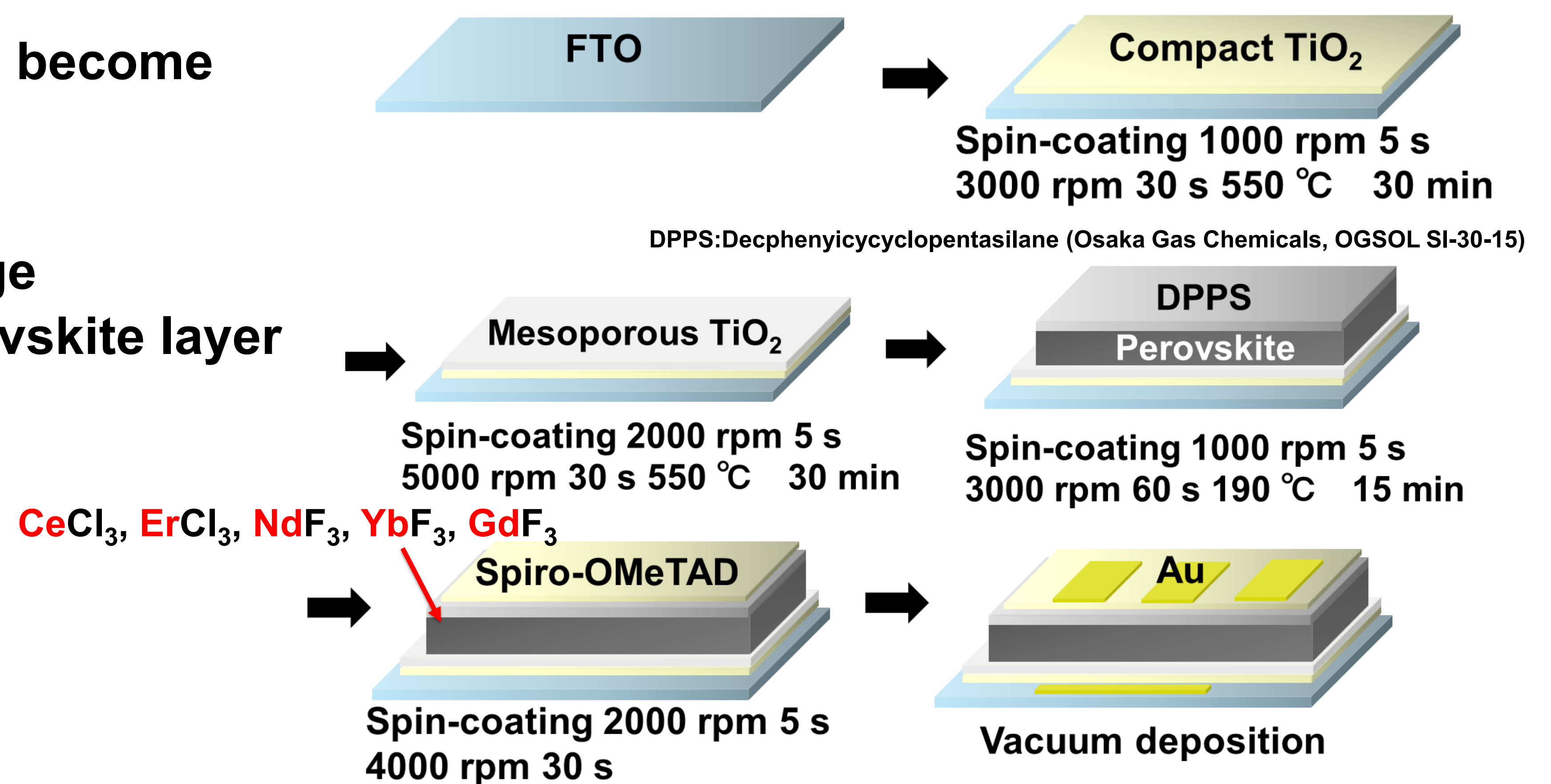
High localization of 4f orbitals

Strong Lewis acidity

Aim

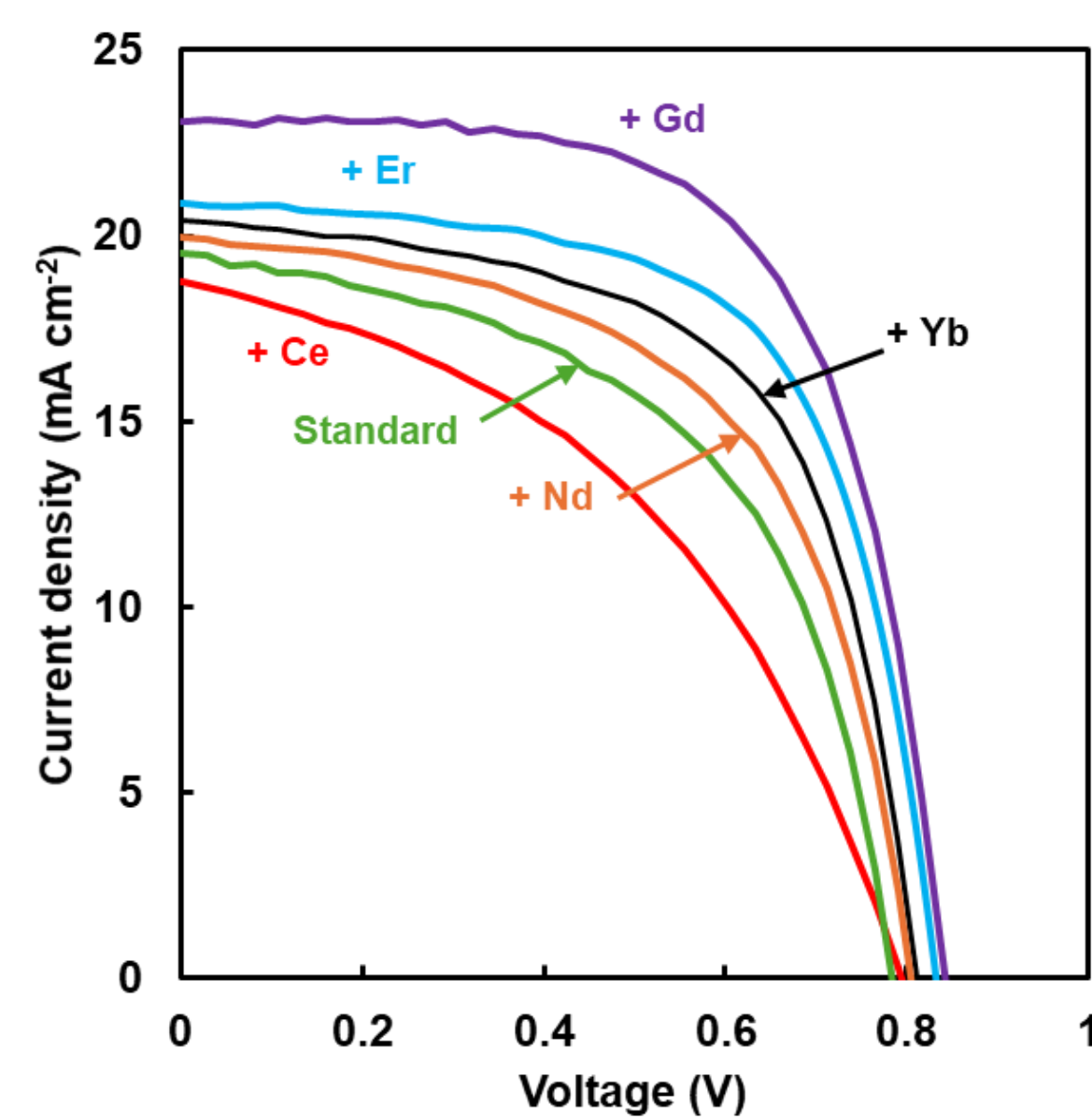
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METHOD

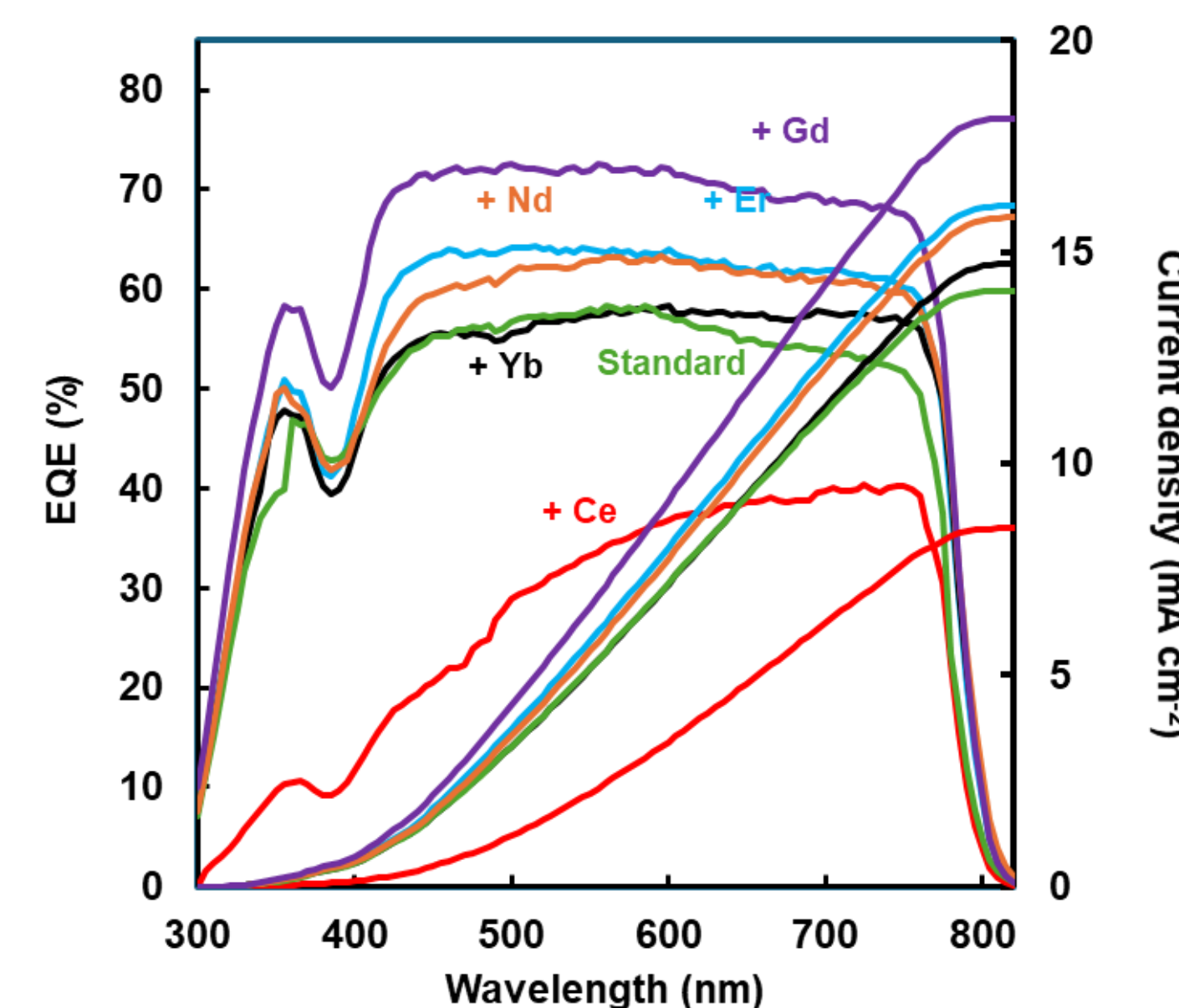


RESULTS & DISCUSSION

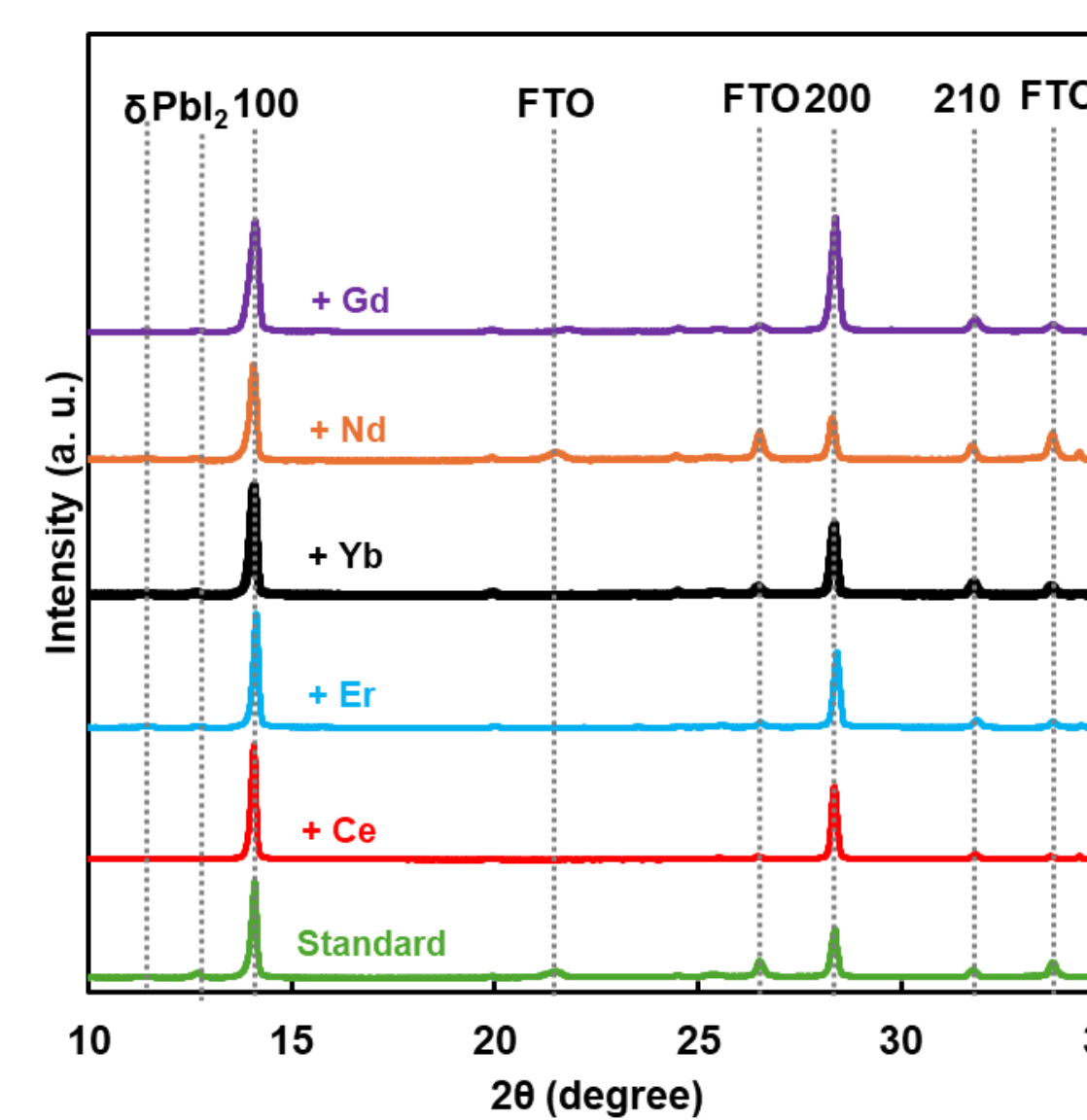
J-V characteristics



External Quantum Efficiency



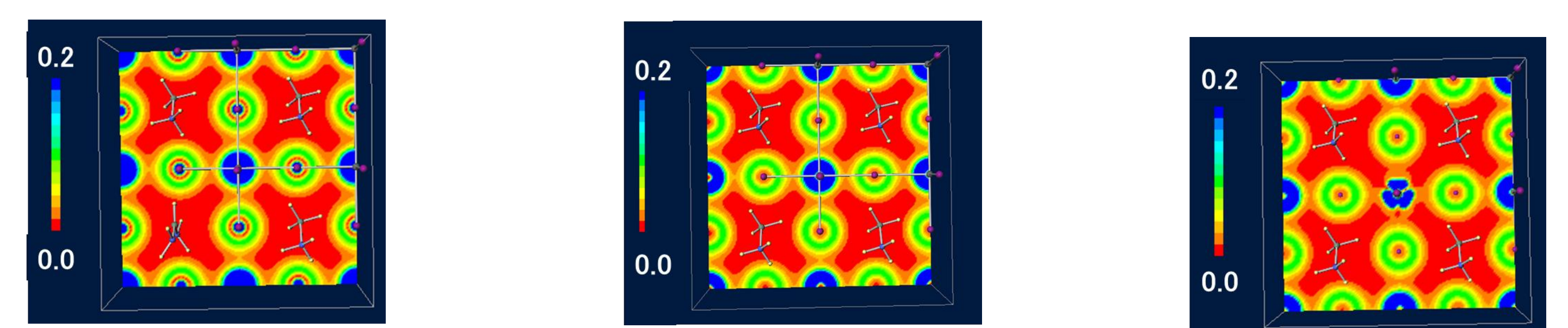
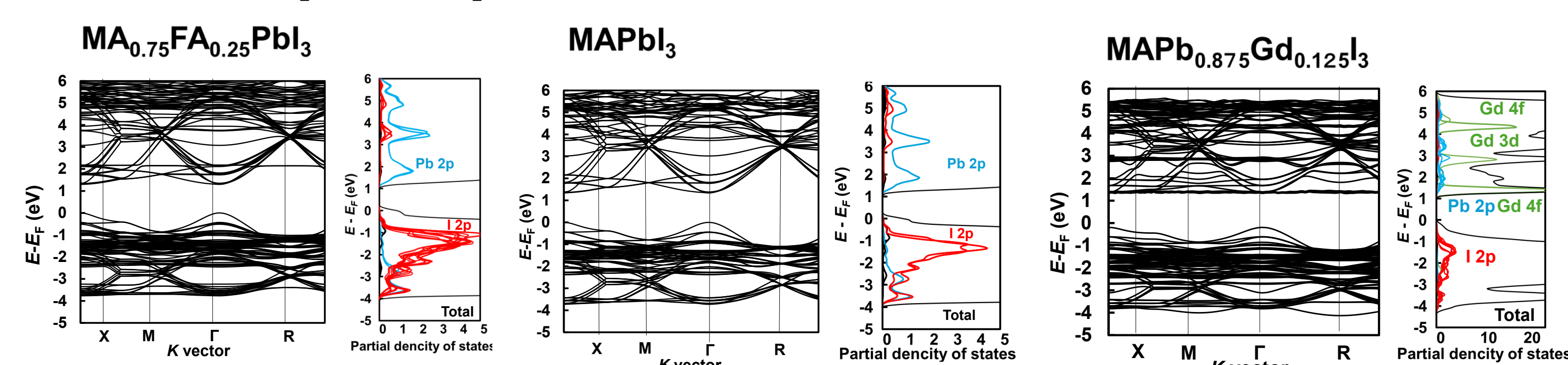
X-ray diffraction



Additive	Lattice constant (Å)	Crystallite size (Å)	I_{100} / I_{210}
Standard	6.289(1)	586	12.3
+ Ce	6.291(1)	696	21.5
+ Er	6.289(0)	657	16.2
+ Yb	6.293(1)	595	8.1
+ Nd	6.298(0)	548	26.1
+ Gd	6.284(2)	334	8.2

✓ By adding Ce, crystal the size and orientation are increased.

First-principles calculation



Crystal model	E_{tot} (eV)	E_g (eV)	m_e^* / m_0	m_h^* / m_0
$MA_{0.75}FA_{0.25}PbI_3$	-3816	1.30	1.09	0.628
$MAPbI_3$	-3808	1.34	1.09	0.655
$MAPb_{0.875}Gd_{0.125}I_3$	-3340	1.57	1.29	0.772

CONCLUSIONS

- ✓ In the Gd1% doped device, suppression of trap density leads to high shunt resistance, increased conversion efficiency, and enhanced long-term stability
- ✓ EDX results confirmed Gd doping within the lattice

FUTURE WORK/ REFERENCES/ACKNOWLEDGMENT

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- [R. Tanaka, et al., Chem. Phys. Lett. 856, 141679 \(2024\).](#)
- [A. Alotaibi, et al., Molecules 29, 2556 \(2024\).](#)
- [Y. Yang, et al., Adv. Mater. 32, 1904347 \(2020\).](#)