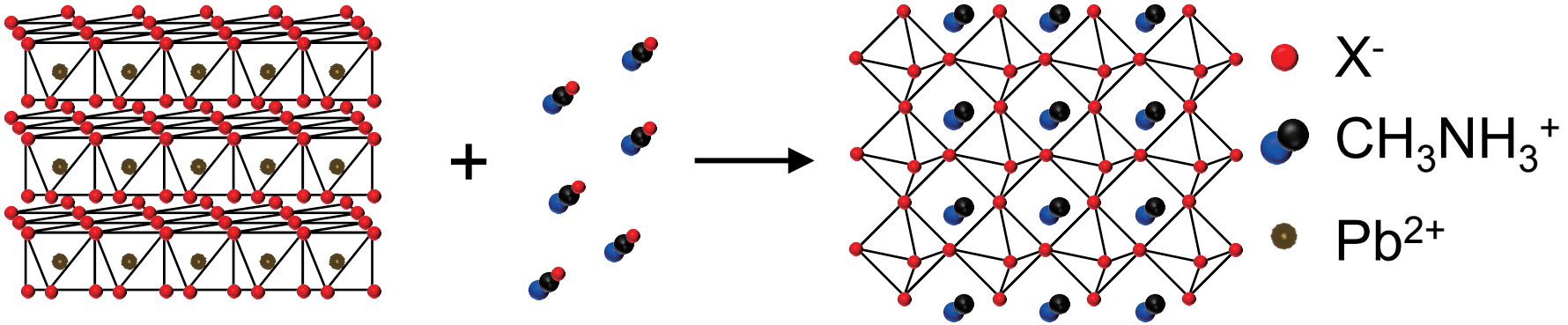
有機鉛ペロブスカイトの製膜制御と結晶成長解析

太陽光発電研究センター
有機系薄膜チーム
宮寺　哲彦

有機鉛ペロブスカイト

$$PbX_2 + CH_3NH_3X \longrightarrow CH_3NH_3PbX_3$$

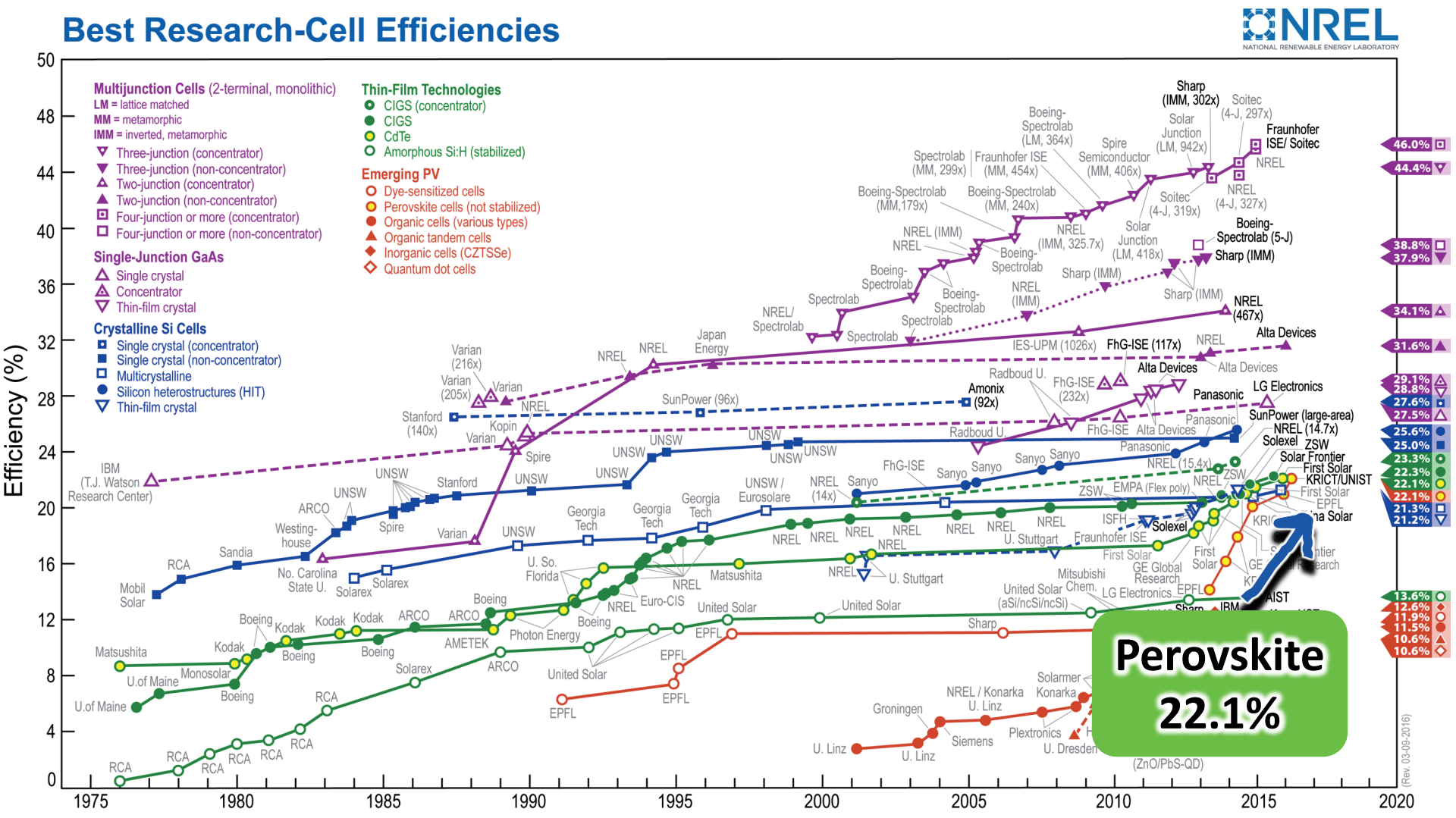


Lead halide　　Amine halide　　Perovskite crystal

High efficiency

Low cost

Best Research-Cell Efficiencies



課題と本研究の取り組み

Issues

Reproducibility

Controllability

Reliability

How to overcome?

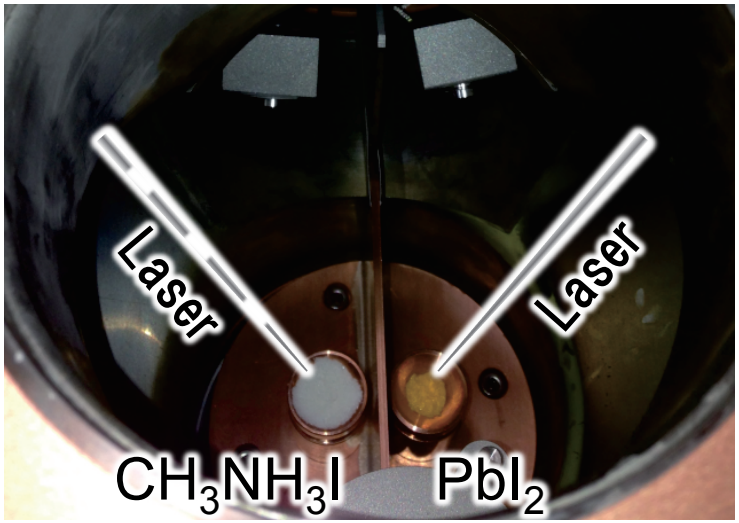
Vacuum process

Novel system: Laser deposition

Understand fundamentals

In-situ X-ray diffraction analysis

レーザー蒸着システム

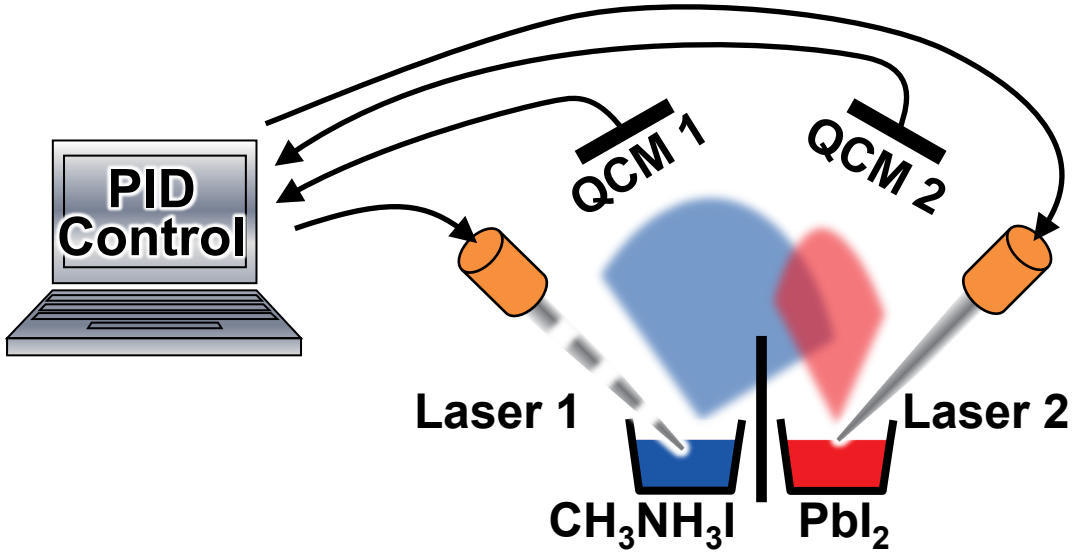


特願2014-175492
Patent: PCT/JP2015/73596

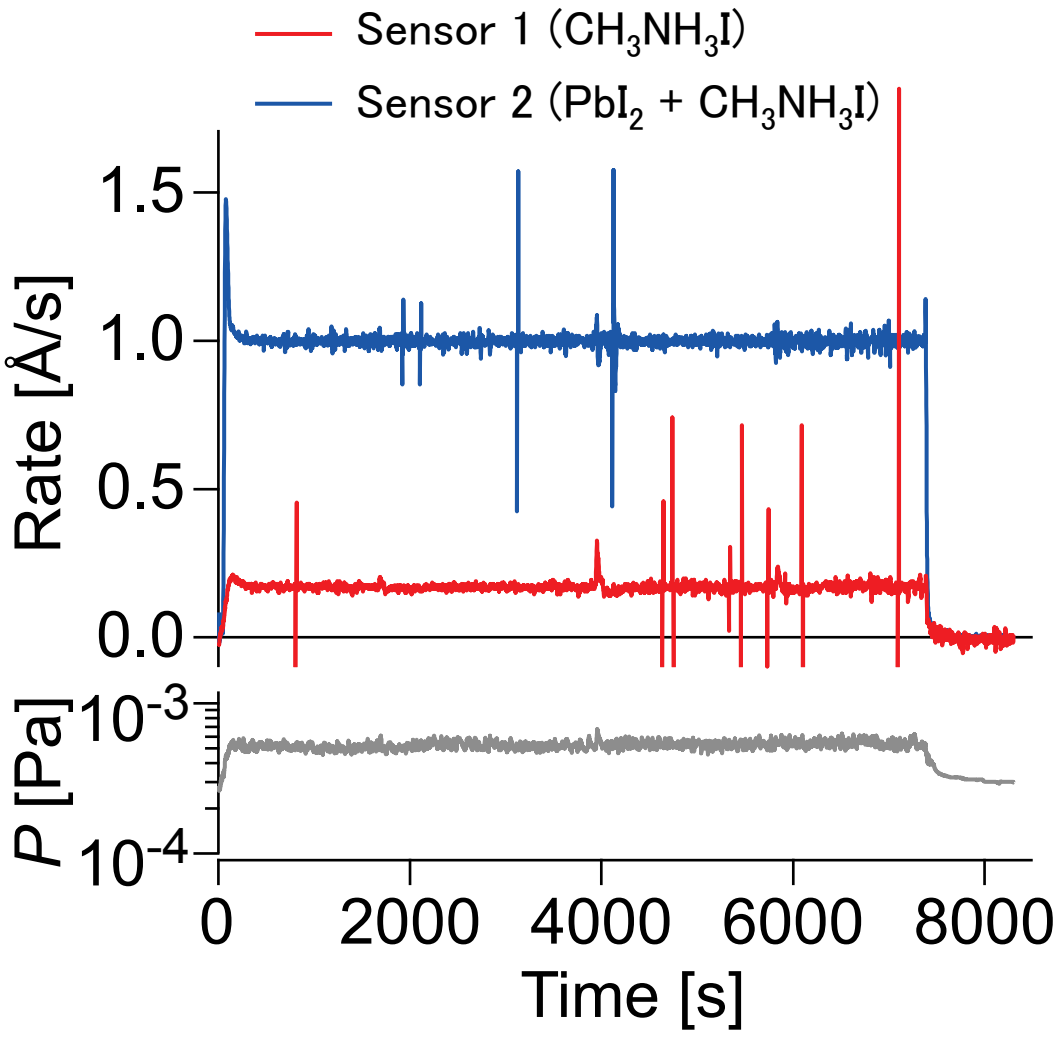
808-nm semiconducting CW laser

Vacuum : 10^{-4}~10^{-3} Pa

Vaporization issue of CH_3NH_3I was overcome



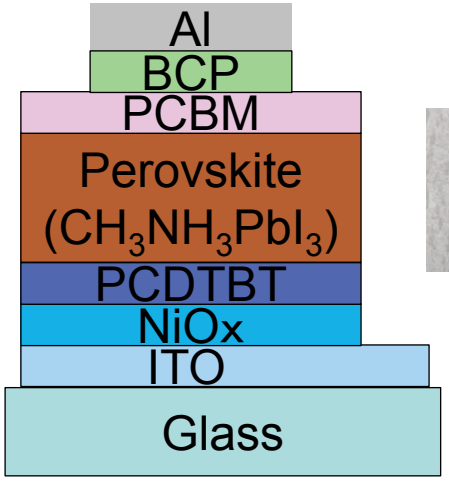
製膜レート制御

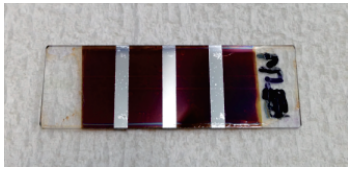


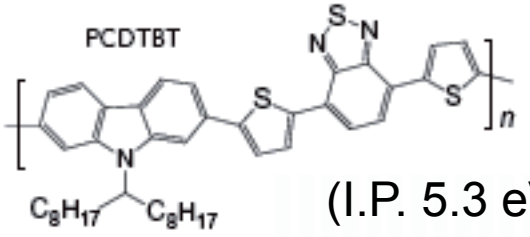
PID parameters

	P	I	D
CH_3NH_3I	0.1	0.04	0
PbI_2	0.02	0.005	0

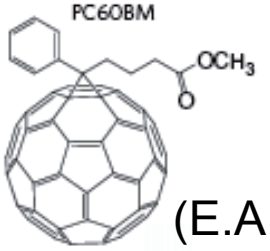
太陽電池特性





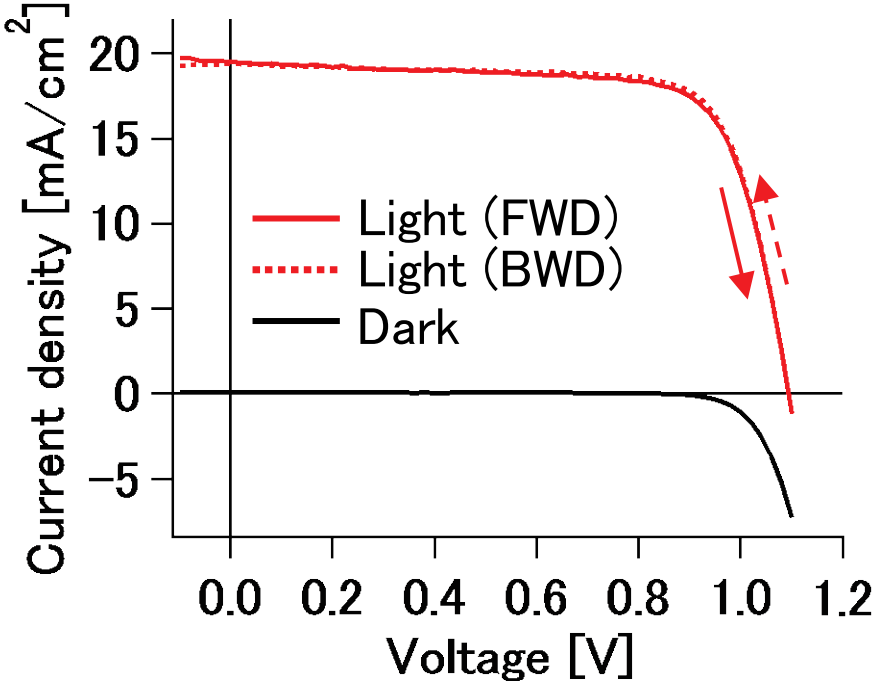


(I.P. 5.3 eV)



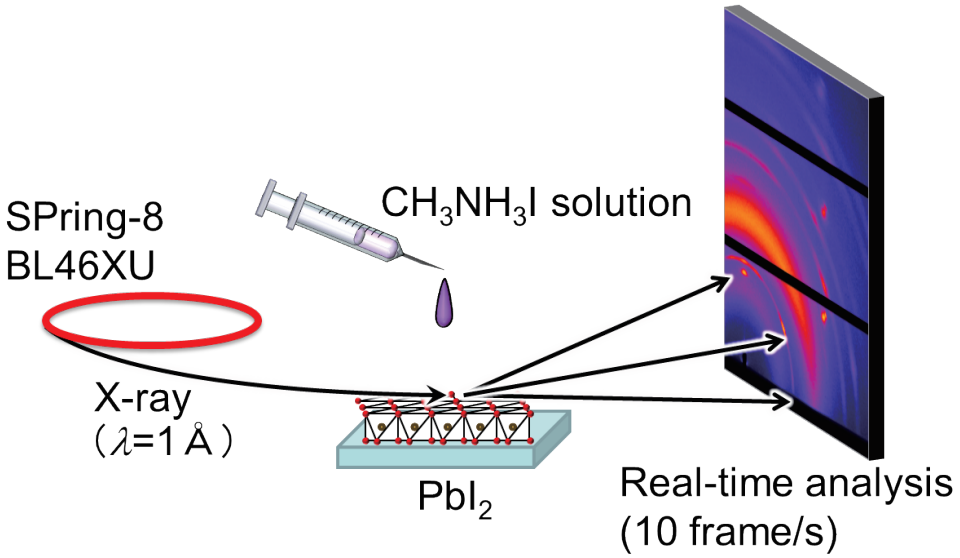
(E.A. 4.2 eV)

NiO_x
(I.P. 5.4 eV)



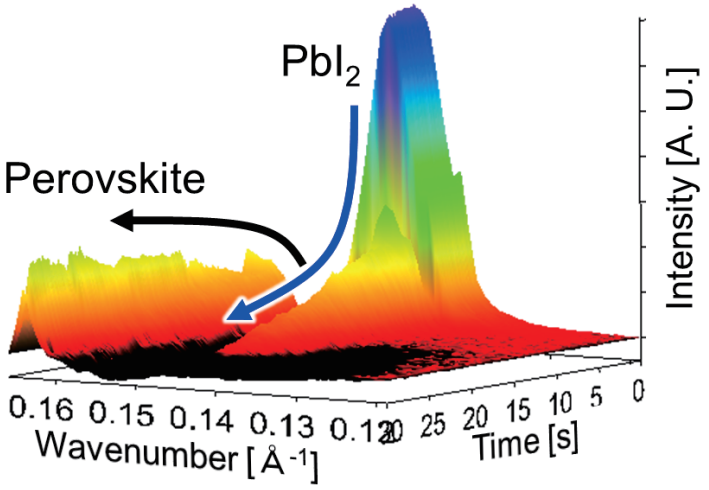
	FWD	BWD	
J_{sc}	19.5	19.3	mA/cm^2
V_{oc}	1.09	1.09	V
FF	0.736	0.760	
PCE	**15.7**	**16.0**	%

結晶成長機構解析

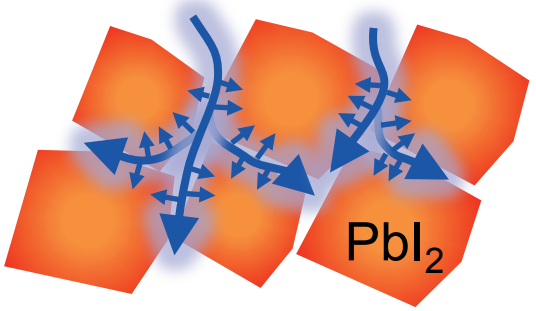


T. Miyadera *et al.*,
Nano Lett. 15, 5630-5634 (2015).

- Anomalous diffusion
- Orientation change



CH_3NH_3I diffusion



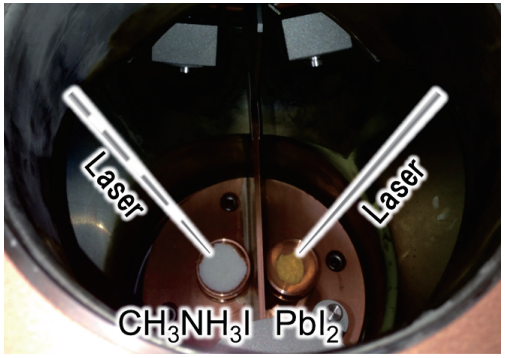
まとめ

- 有機鉛ペロブスカイト製膜制御

  レーザー蒸着法

  製膜レート制御を実現

  光電変換効率：15.7%(順)，　16.0%(逆)



- 結晶成長機構解析

  リアルタイム観察（SPring-8）

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