

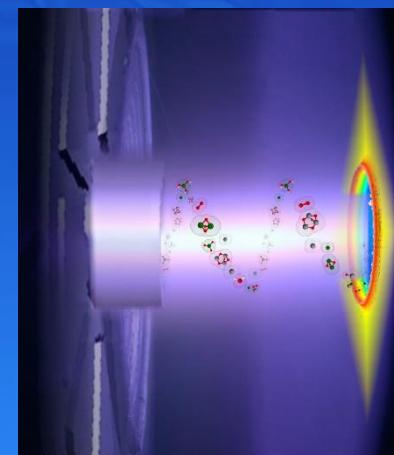
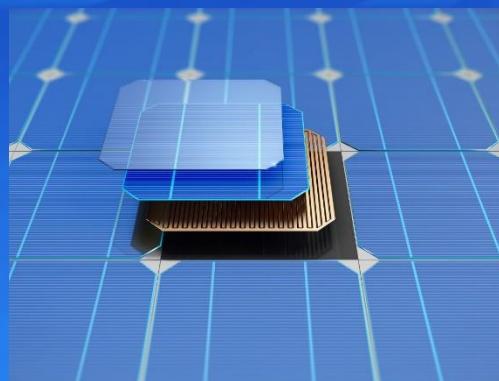


HORIBA
Explore the future

HORIBA Scientific

Bernd Bleisteiner - Application

Analyse von Strukturen und eingebetteten Schnittstellen mit gepulsten HF GDOES



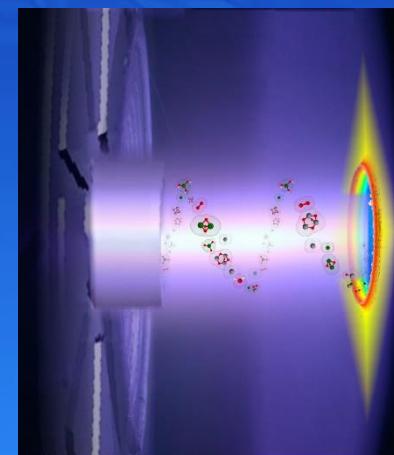
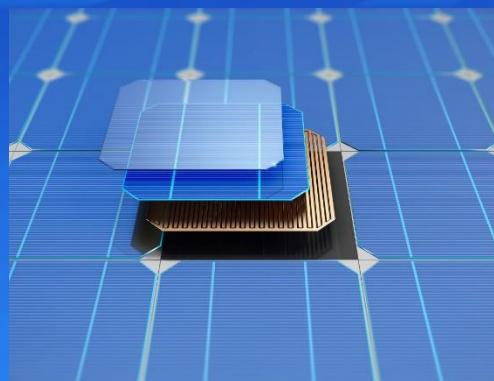
27/9/2019

HORIBA Scientific

Bernd Bleisteiner – Application

Sascha Just – Sales

Analyse von Strukturen und eingebetteten Schnittstellen mit gepulsten HF GDOES

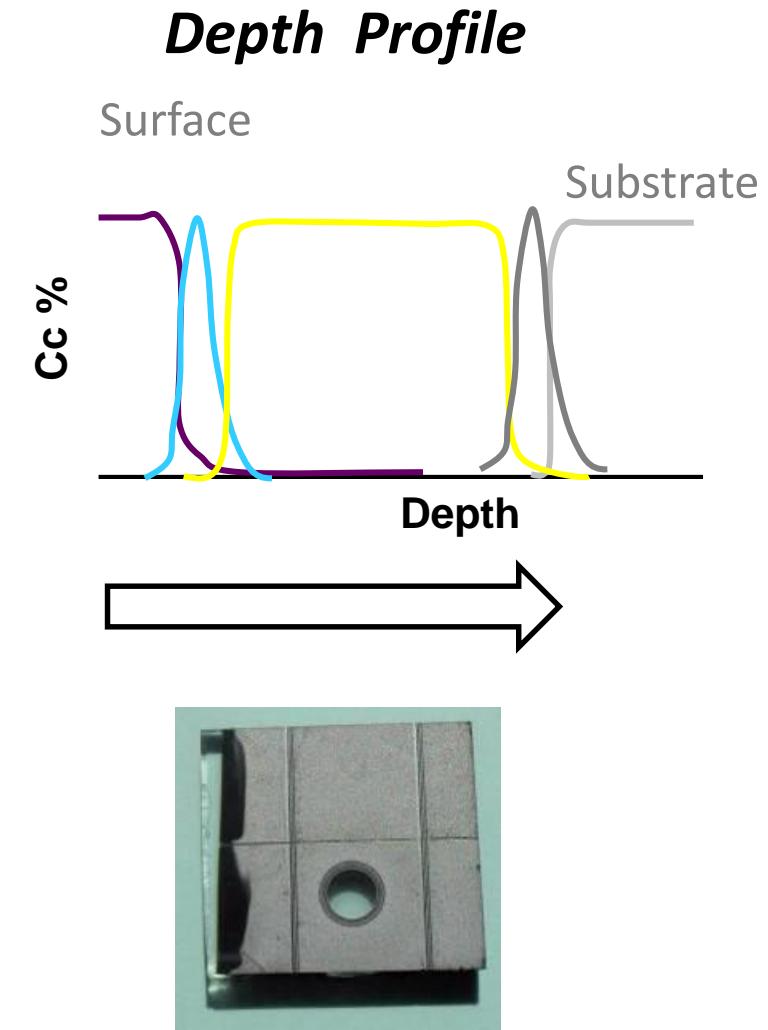
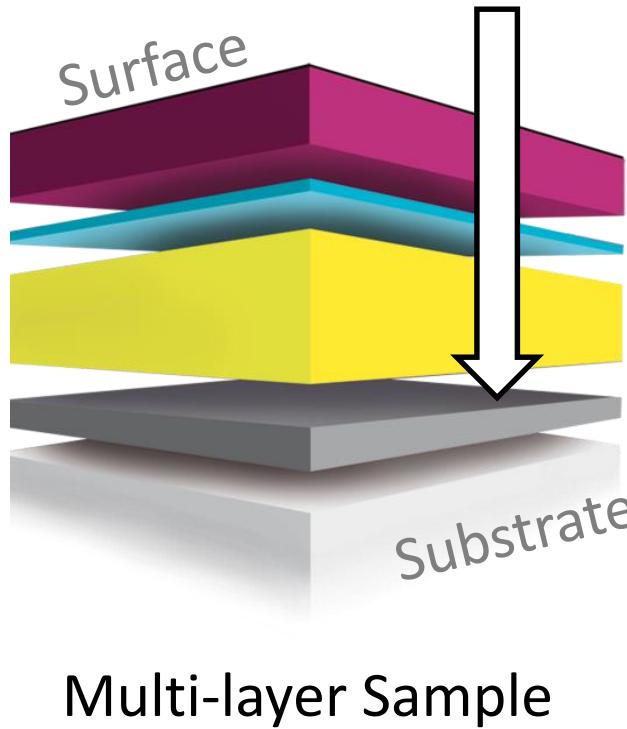


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Content

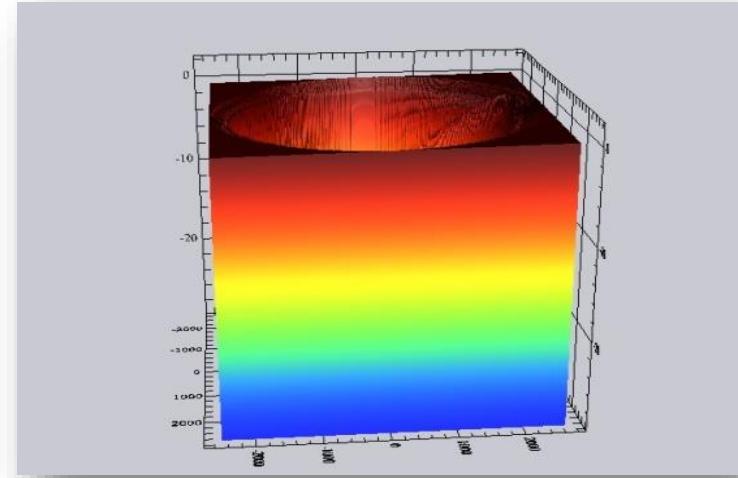
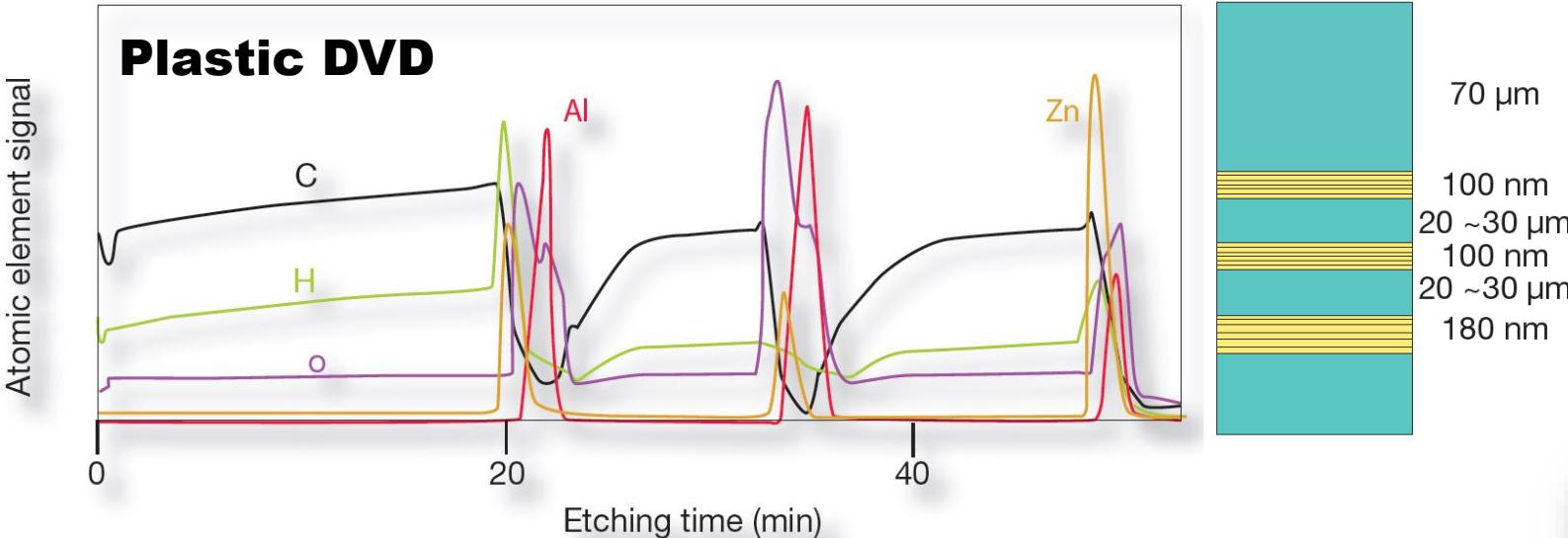
- **GDS one method for surface and interface analysis**
- **UFS Ultra Fast Sputtering – a short introduction**
- **UFS in investigation of Perovskite thin solar cells**

Fast Elemental Depth Profiles



Ultra Fast Sputtering

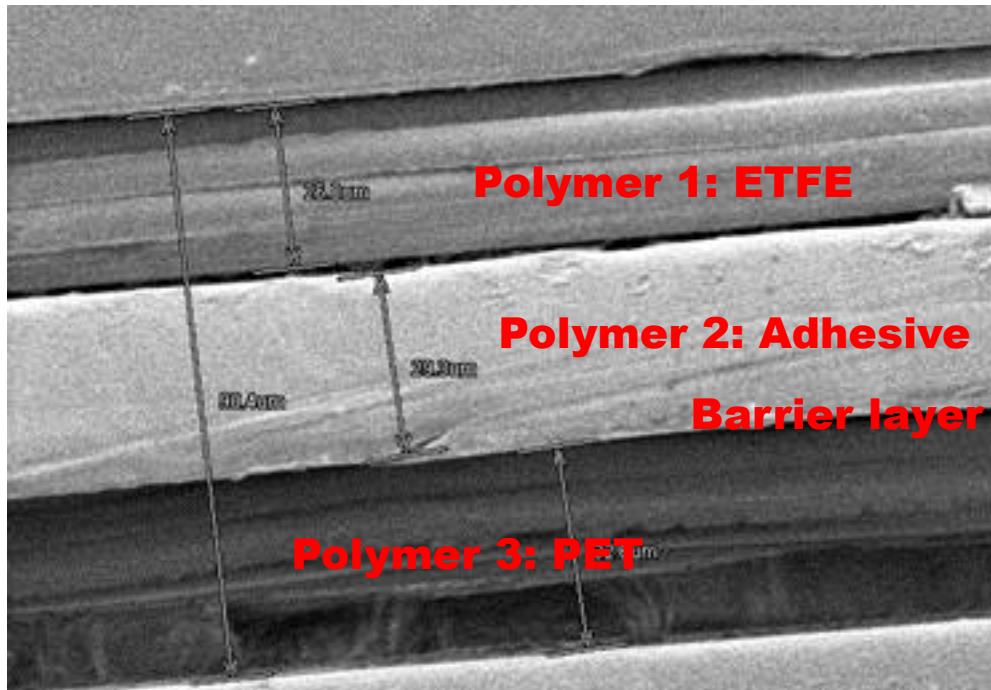
Polymer, patented UFS



The patented UFS allows for Ultra Fast Sputtering of polymeric layers offering enhanced signal/noise ratios and the ability to measure embedded layers below thick polymeric ones with excellent depth resolution. The example here shows a DVD featuring 6 layers, 3 around 100 nm, each below thick polymeric layers.



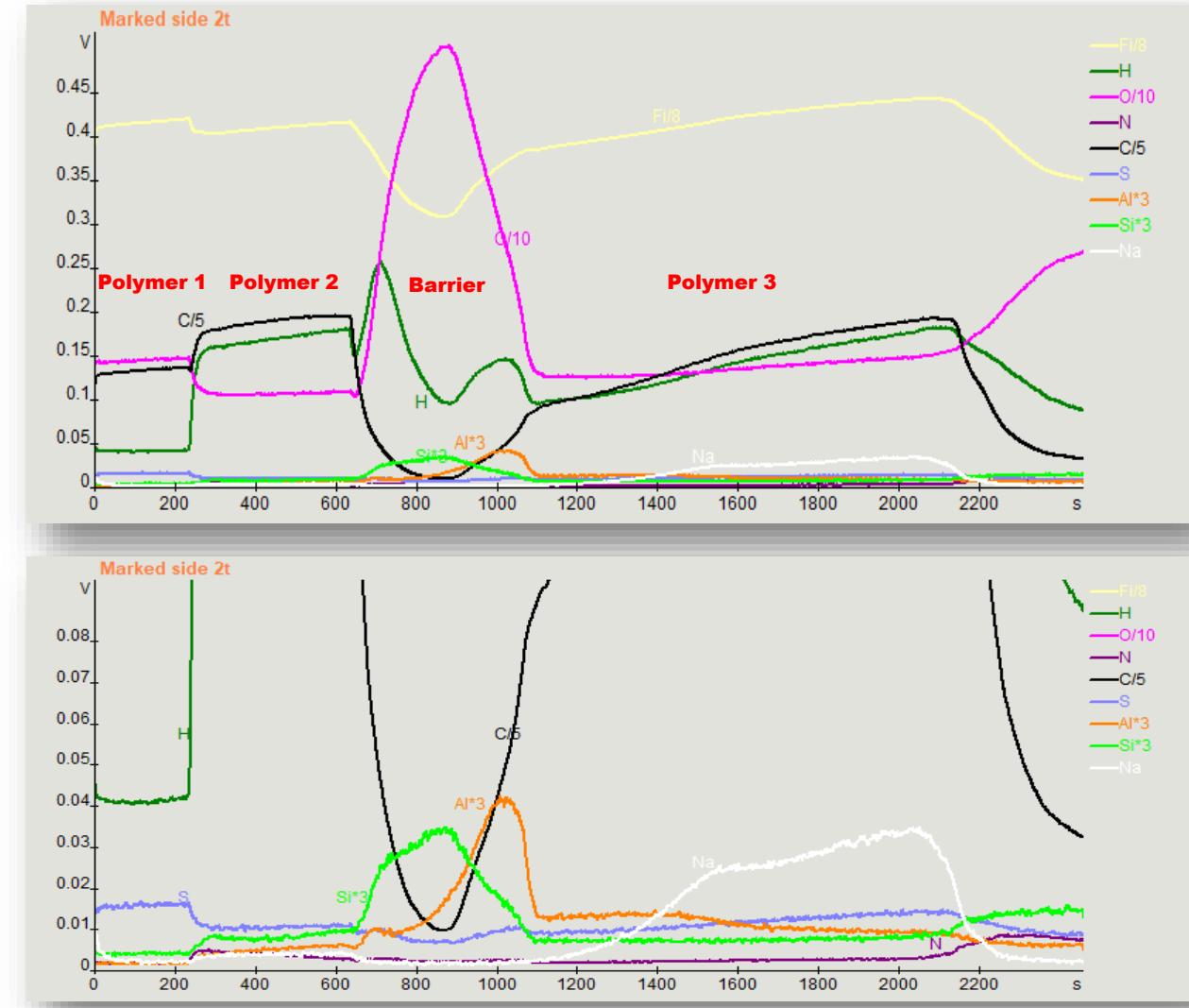
UFS: Access to embedded layers



Multilayered organic film

Detection of buried SiO_x and AlO_x layers between polymeric layers

Barrier layer just a few nm thick



Research in Perovskite solar cells



université
PARIS-SACLAY



THÈSES

Présentée pour obtenir le grade de

DOCTEUR DE L'ÉCOLE POLYTECHNIQUE

Spécialité : Physique

Par

Heejae LEE

Analysis of Current-Voltage Hysteresis and Ageing Characteristics for $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$ Based Perovskite Thin Film Solar Cells



<http://pubs.acs.org/journal/aelccp>

Direct Experimental Evidence of Halide Ionic Migration under Bias in $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$ -Based Perovskite Solar Cells Using GD-OES Analysis

Heejae Lee,[†] Sofia Gaiaschi,[‡] Patrick Chapon,[‡] Arthur Marronnier,[†] Heeryung Lee,[†] Jean-Charles Vanel,[†] Denis Tondelier,[†] Jean-Eric Bourée,[†] Yvan Bonnassieux,[†] and Bernard Geffroy^{*§,‡,¶}

[†]LPICM, CNRS, Ecole Polytechnique, Université Paris-Saclay, 91128 Palaiseau Cedex, France

[‡]Horiba Jobin Yvon S.A.S., 16-18 rue du canal, 91165 Longjumeau Cedex, France

[§]LICSEN, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay, 91191 Gif-sur-Yvette Cedex, France



Cite This: *J. Phys. Chem. C* 2019, 123, 17728–17734

Article

pubs.acs.org/JPCC

Effect of Halide Ion Migration on the Electrical Properties of Methylammonium Lead Tri-Iodide Perovskite Solar Cells

Heejae Lee,[†] Sofia Gaiaschi,[‡] Patrick Chapon,[‡] Denis Tondelier,[†] Jean-Eric Bourée,[†] Yvan Bonnassieux,[†] Vincent Derycke,^{§,¶} and Bernard Geffroy^{*§,‡,¶}

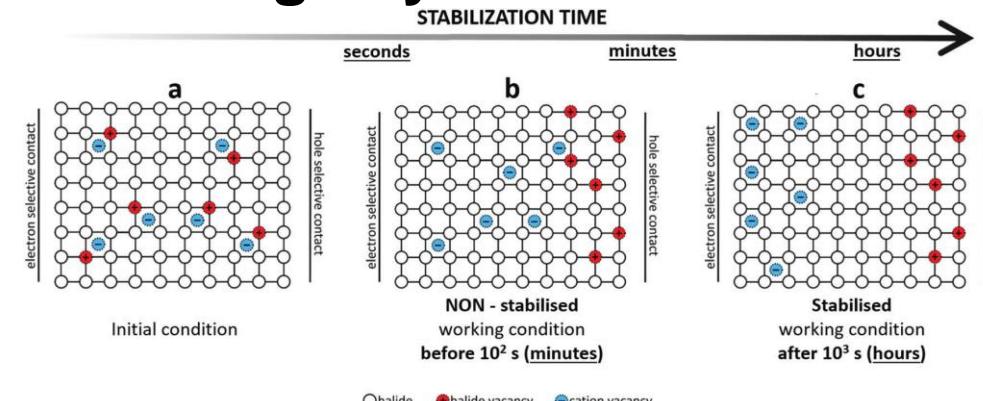
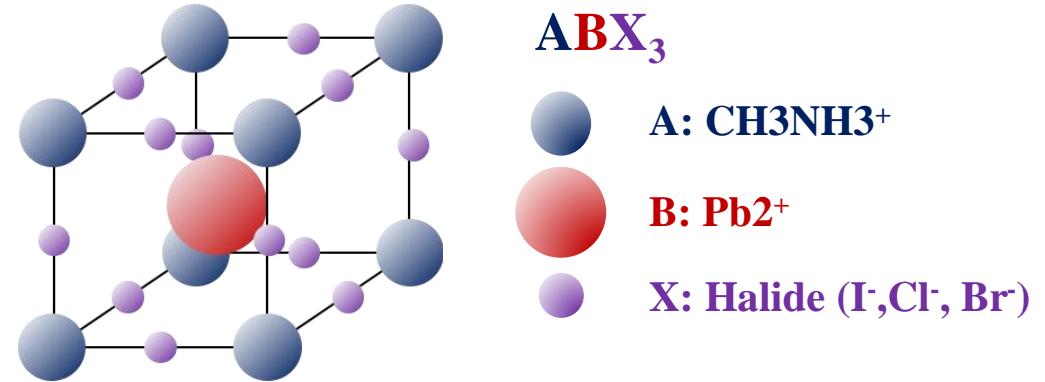
[†]LPICM, CNRS, Ecole Polytechnique, Institut Polytechnique de Paris, route de Saclay, 91128 Palaiseau, France

[‡]Horiba Jobin Yvon S.A.S., 16-18 rue du canal, 91165 Longjumeau Cedex, France

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Research in Perovskite solar cells

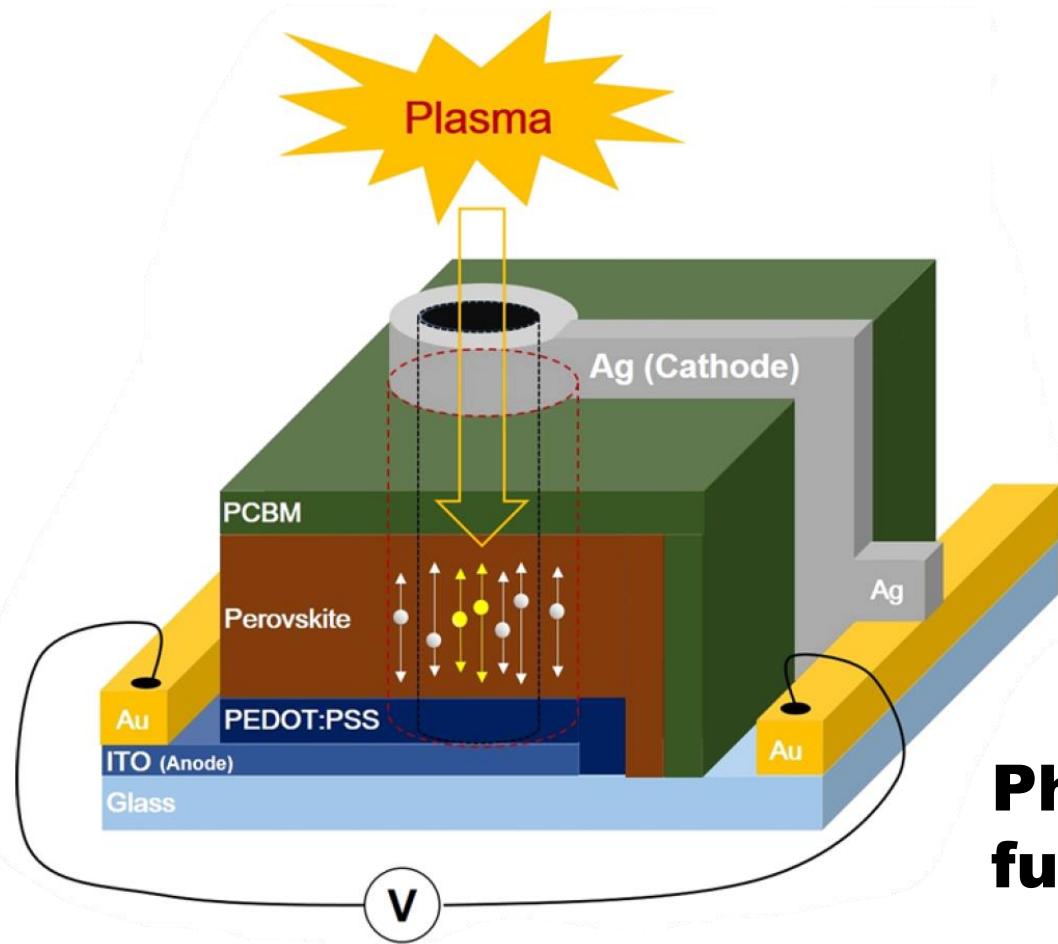
- Low price material and easy fabrication process
- High performance: > 23% of efficiency in Single structure solar cells
 - High light absorption
 - High diffusion length
 - Low exciton binding energy
- But stability issues and high current - voltage hysteresis
 - Ferroelectric property
 - Ion migration
 - Trap states



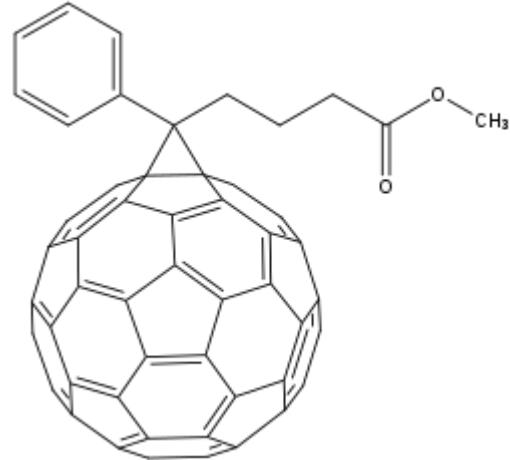
A. Abate, et. al., Energy & Environmental Science, 2017, DOI:10.1039/c6ee03352k

Sample description

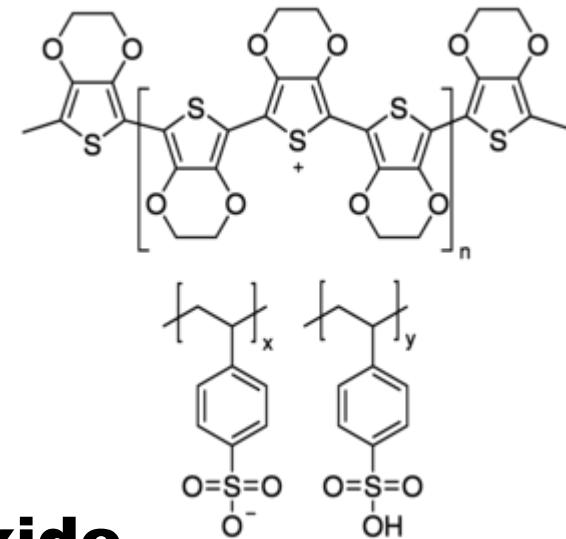
Full device of PSCs



PCBM:

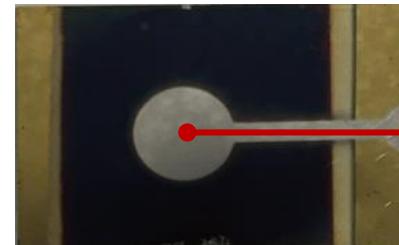


PEDOT:PSS:



ITO: Indium Tin Oxide

Photo of full device

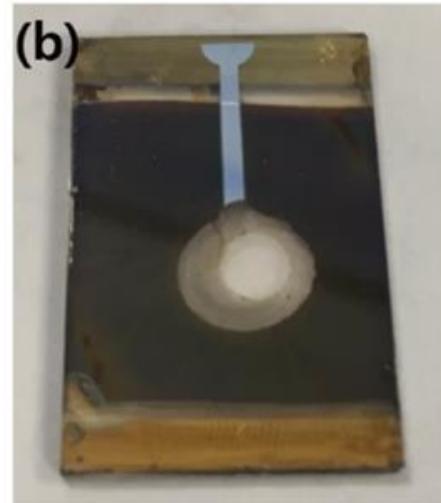
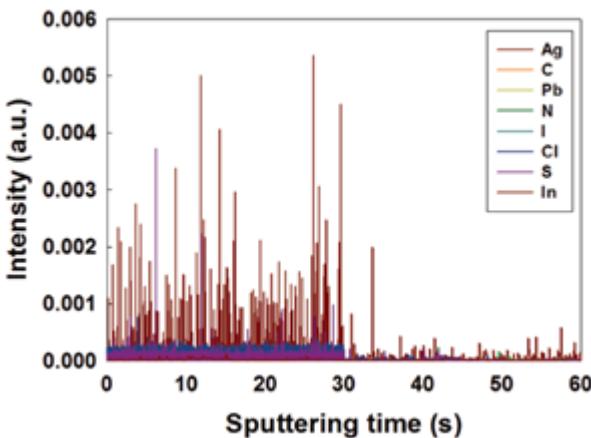


Active area: Ø 6 mm

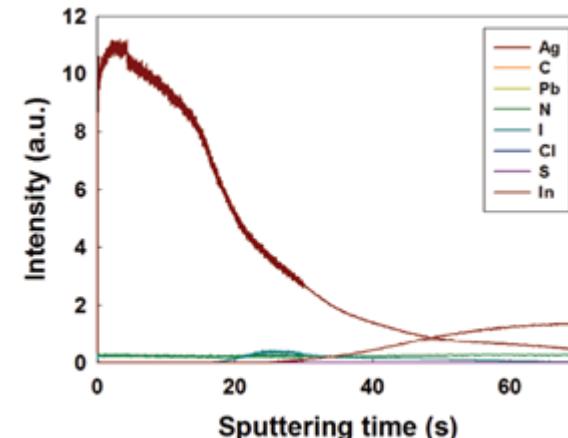
Plasma conditions



without pulse



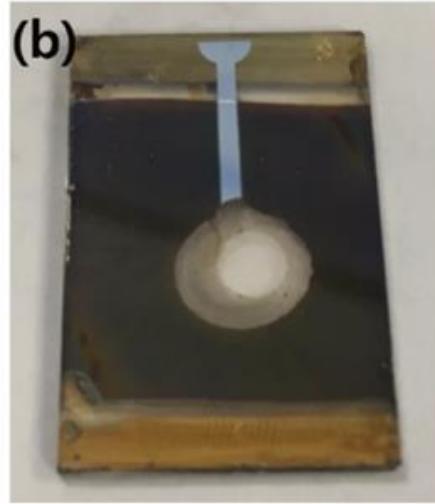
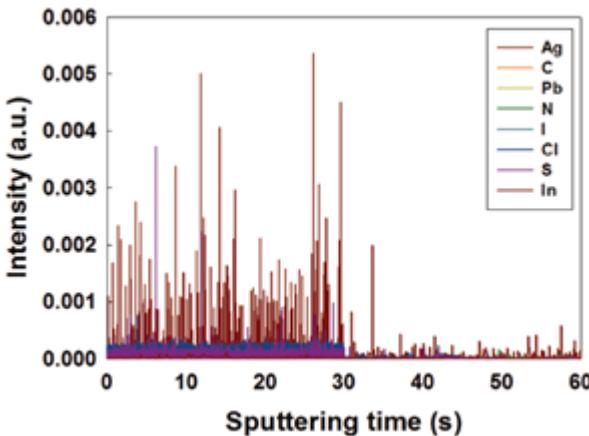
pulsed



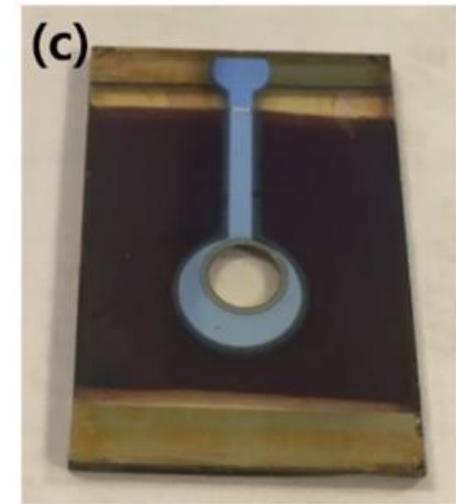
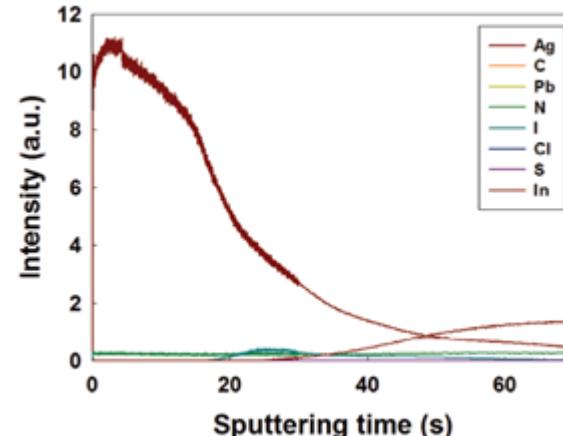
Plasma conditions



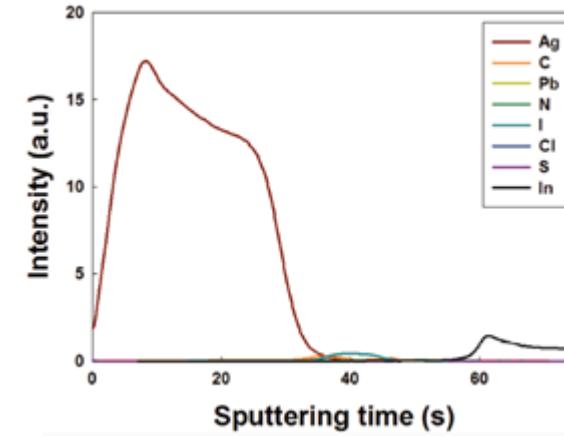
without pulse



pulsed

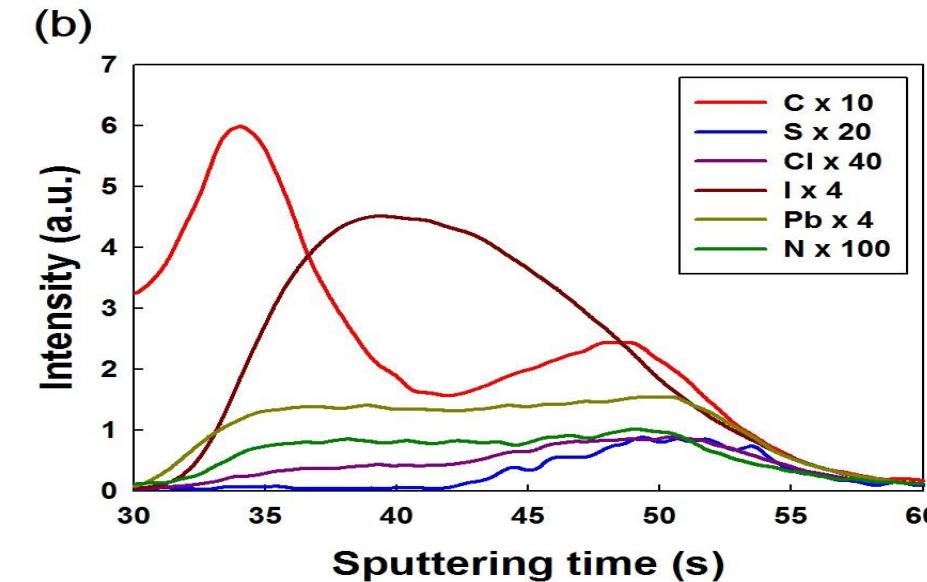
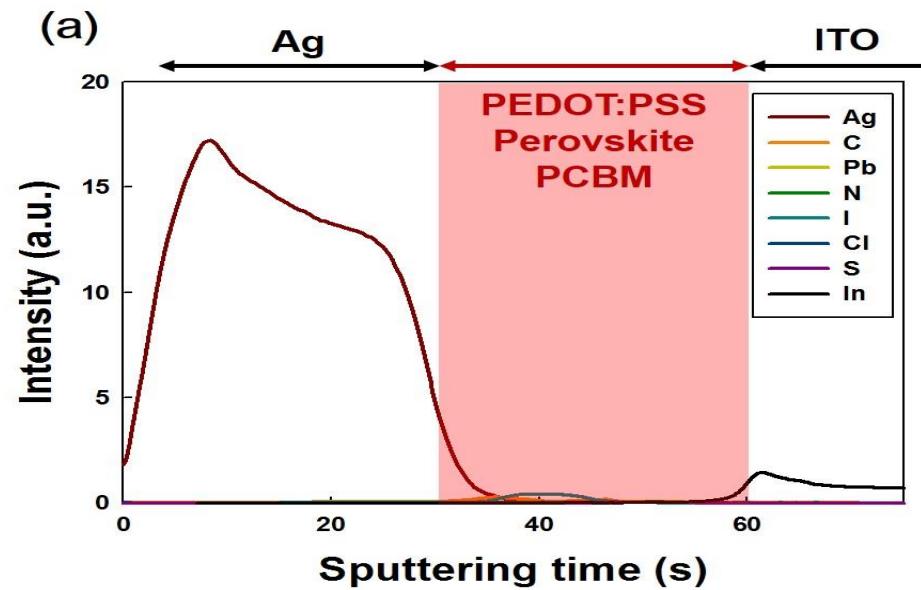


pulsed + UFS

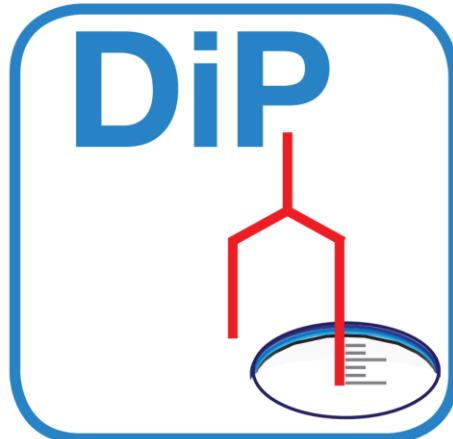


Plasma conditions Ar/O₂ gas mix

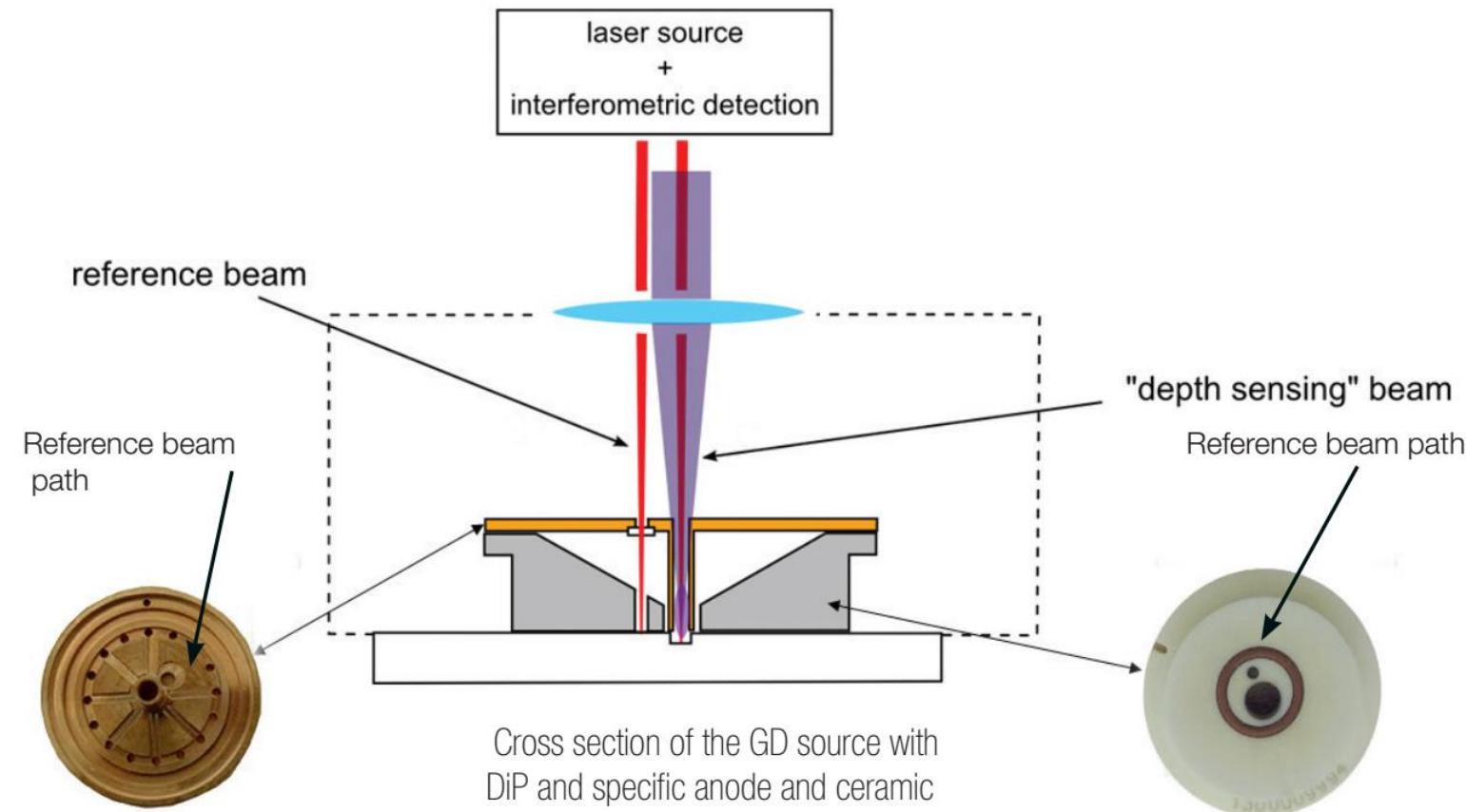
- Relative slow sputtering of the top Ag layer
- Fast sputtering of the organic layers
- Sharper profiles between layer and interface of interest



ACHTUNG WERBUNG



Differential Interferometry Profiling

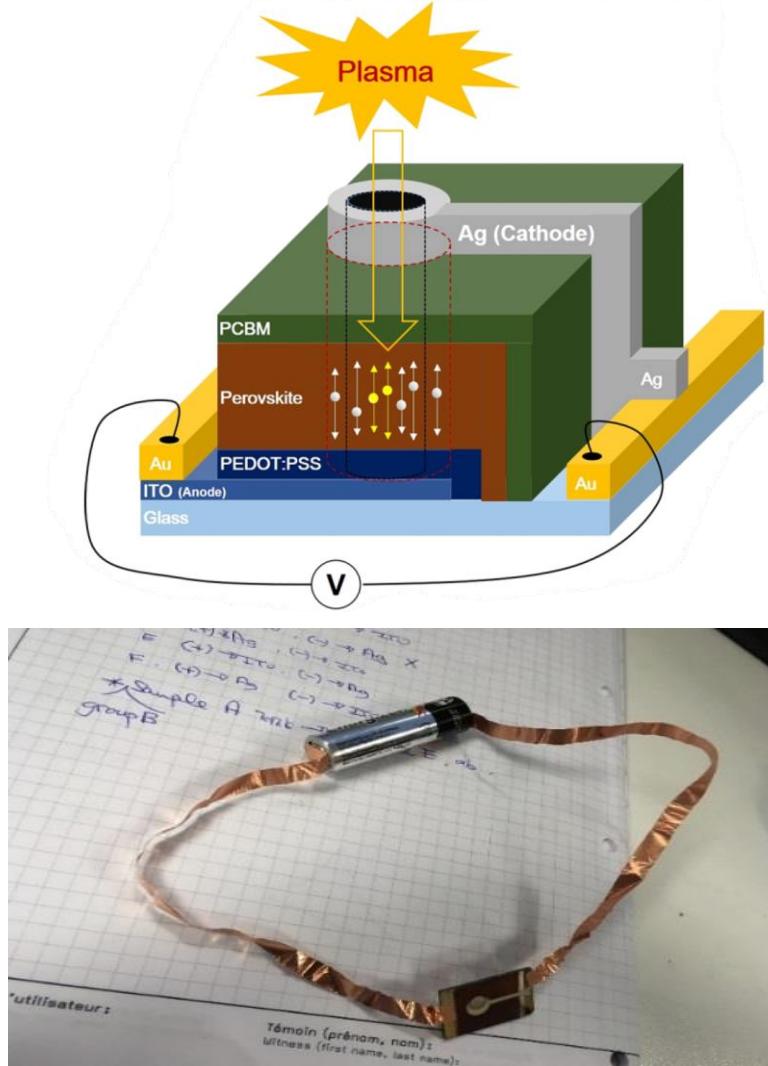


Operating mode

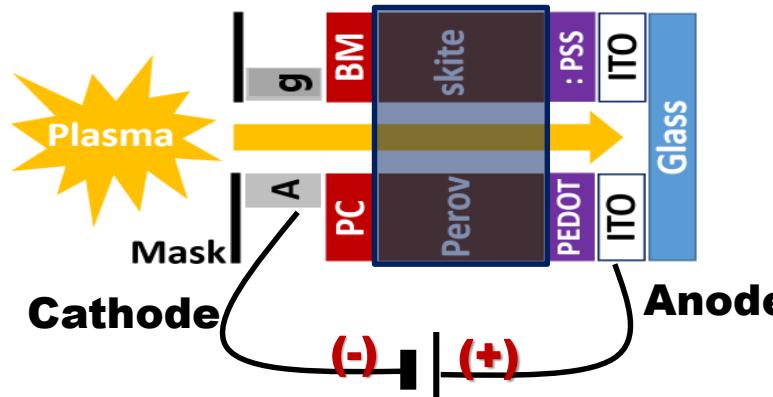
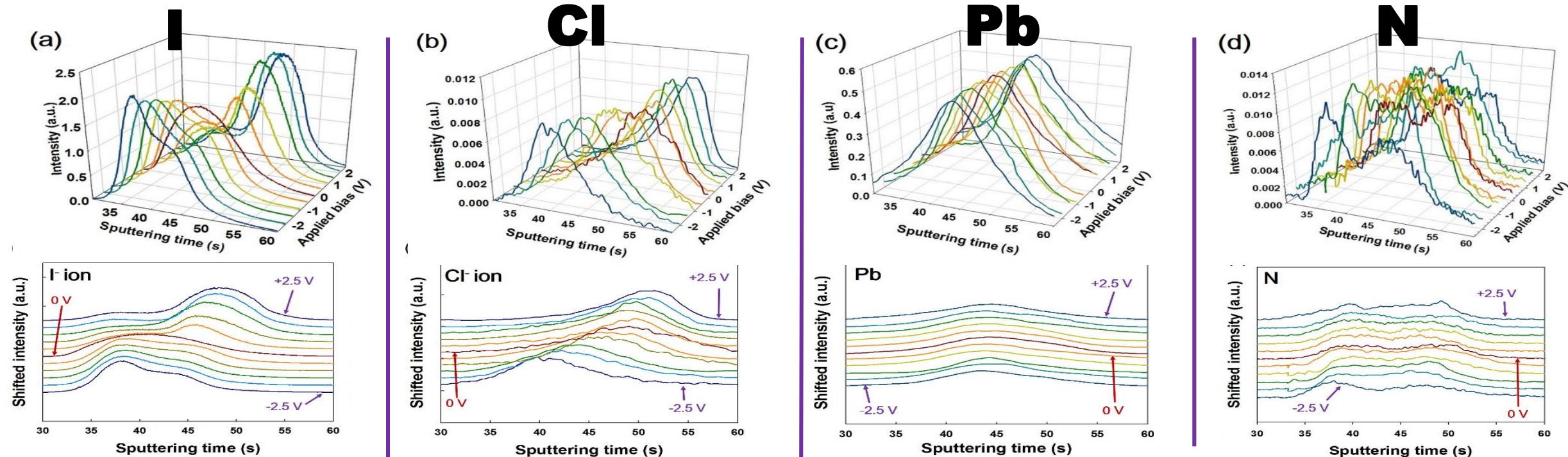
Check of ion migration under bias

**Voltage was applied before and during GD experiments
+2,5 V until - 2,5 V**

**Independent set of batteries
(Or power supply)**

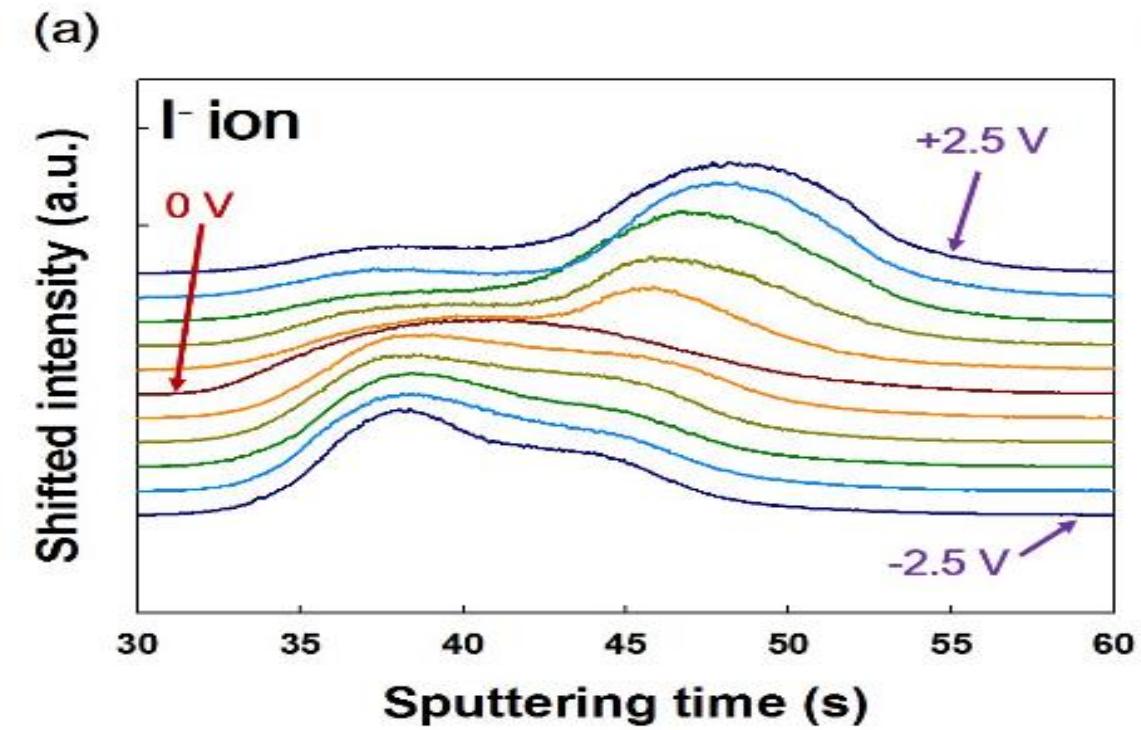
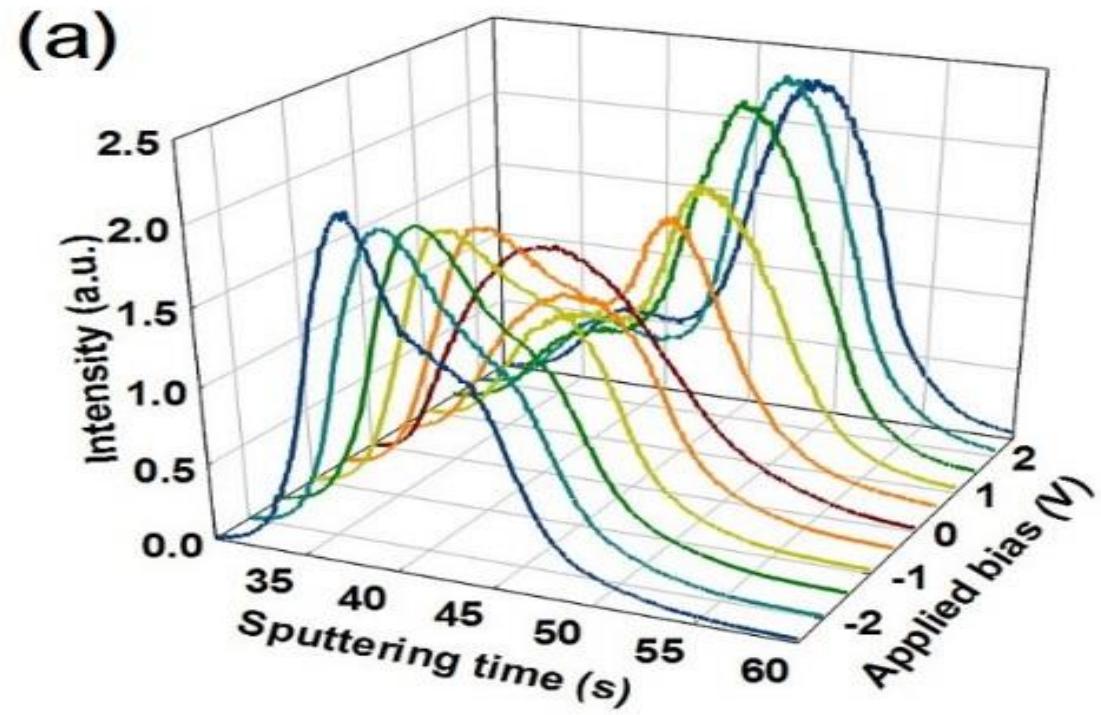
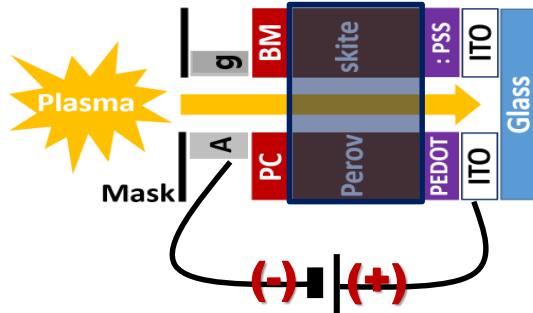


Ion migration driven by bias



- Perovskite → Lead, Iodine, Chlorine, Nitrogen line
- Applied bias : -2.5V ~ +2.5V (Each 0.5V) versus anode
- Lead and Nitrogen : No migration
- Halide ions (Iodine and Chlorine) : Migration
 - Shift toward PCBM under negative bias
 - Shift toward PEDOT:PSS under positive bias
- Iodine line : Second peak generation under applied bias

Ion migration of iodide driven by bias



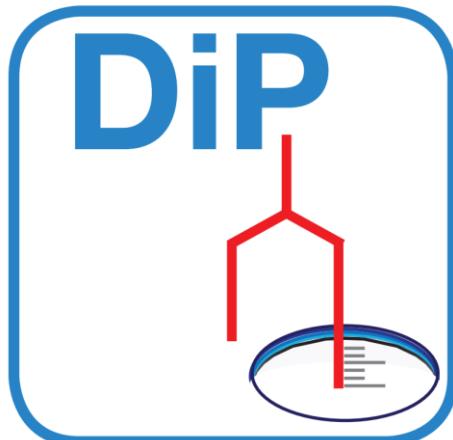
Conclusion

Conclusion

UFS can be a solution for special topics like polymers or thin metallic interfaces

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UFS can be a solution for special topics like polymers or thin metallic interfaces



Thank you

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bernd.bleisteiner@horiba.com



Thank you

Omoshiro-okashiku
Joy and Fun



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감사합니다

Cảm ơn

ありがとうございました

Dziękuję

ধন্যবাদ

Grazie

Merci

ធម្មរោប់

நன்றா

謝謝

Obrigado

Σας ευχαριστούμε

Tack ska ni ha

شُكْرًا

Большое спасибо

Danke

Gracias