

HySPRINT INDUSTRY DAY:
New Frontiers in PV Research:
Emerging Perovskite Semiconductors

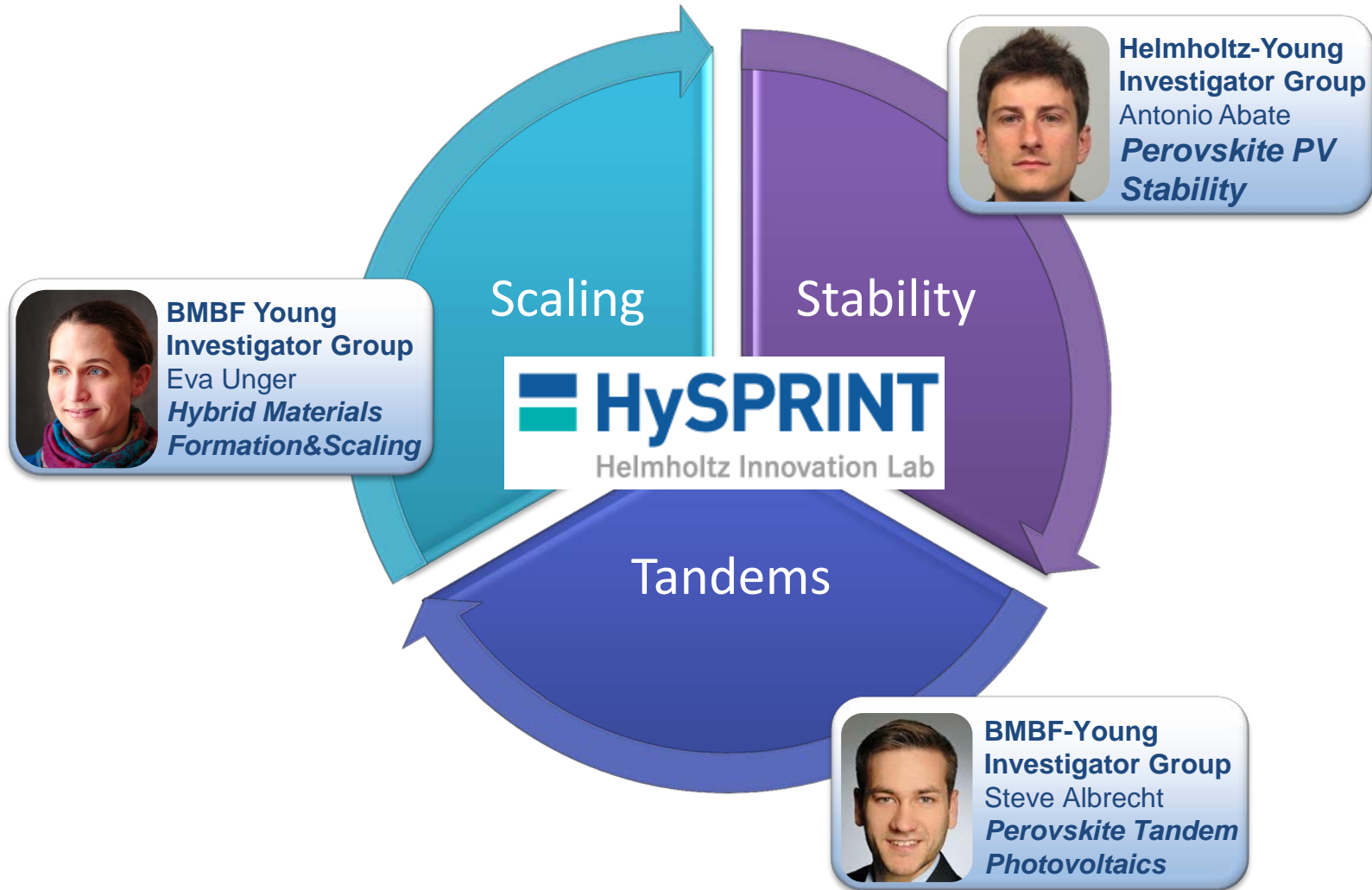
13th Oct 2017

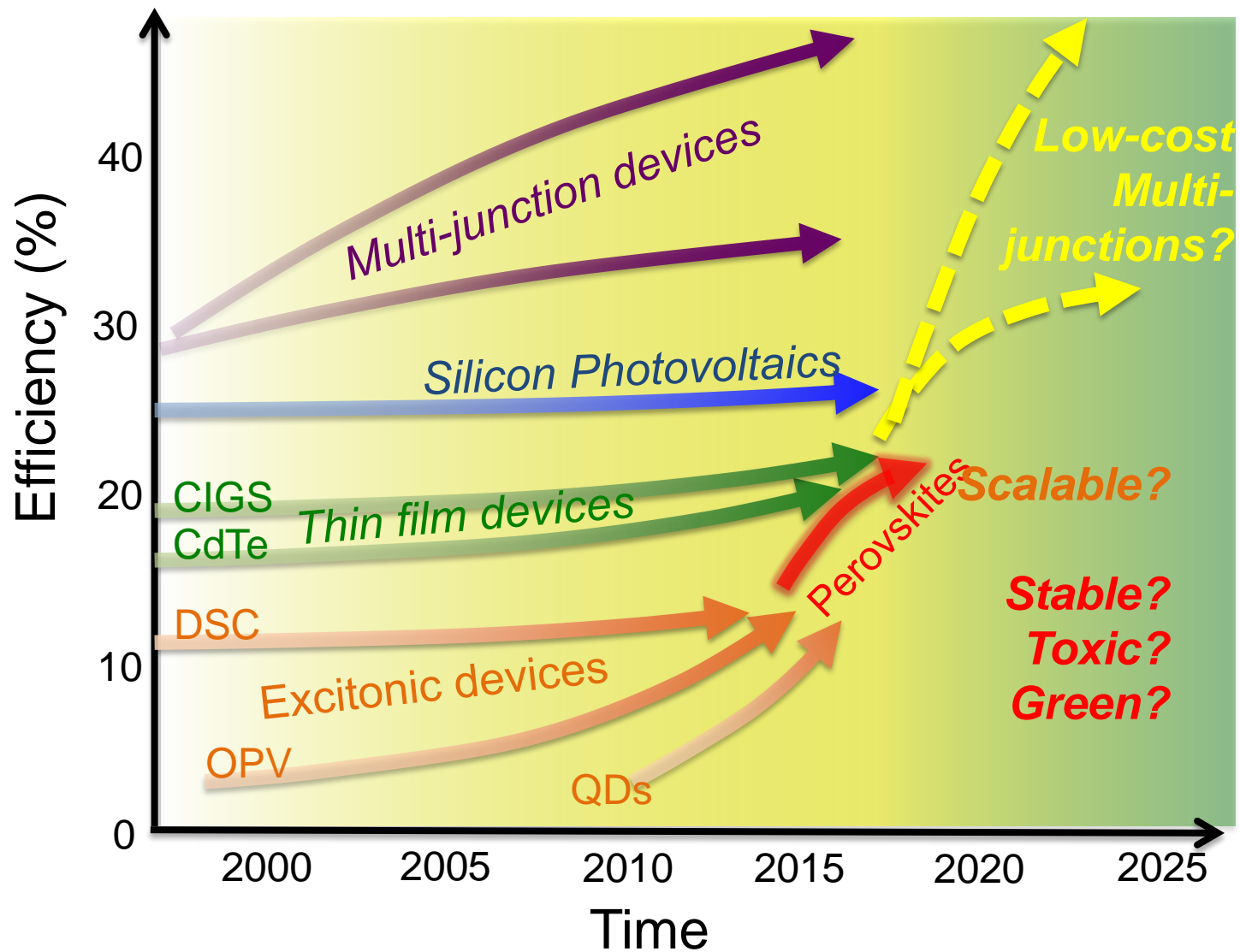
SCALING PEROVSKITE SOLAR CELLS

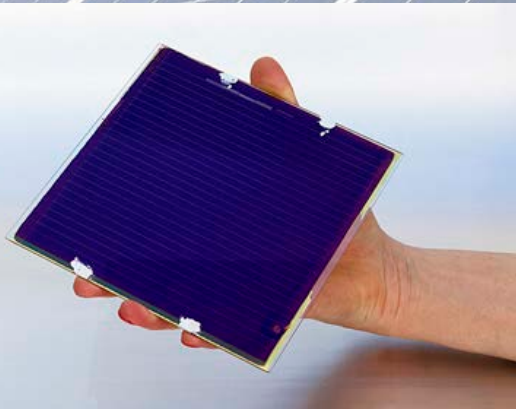
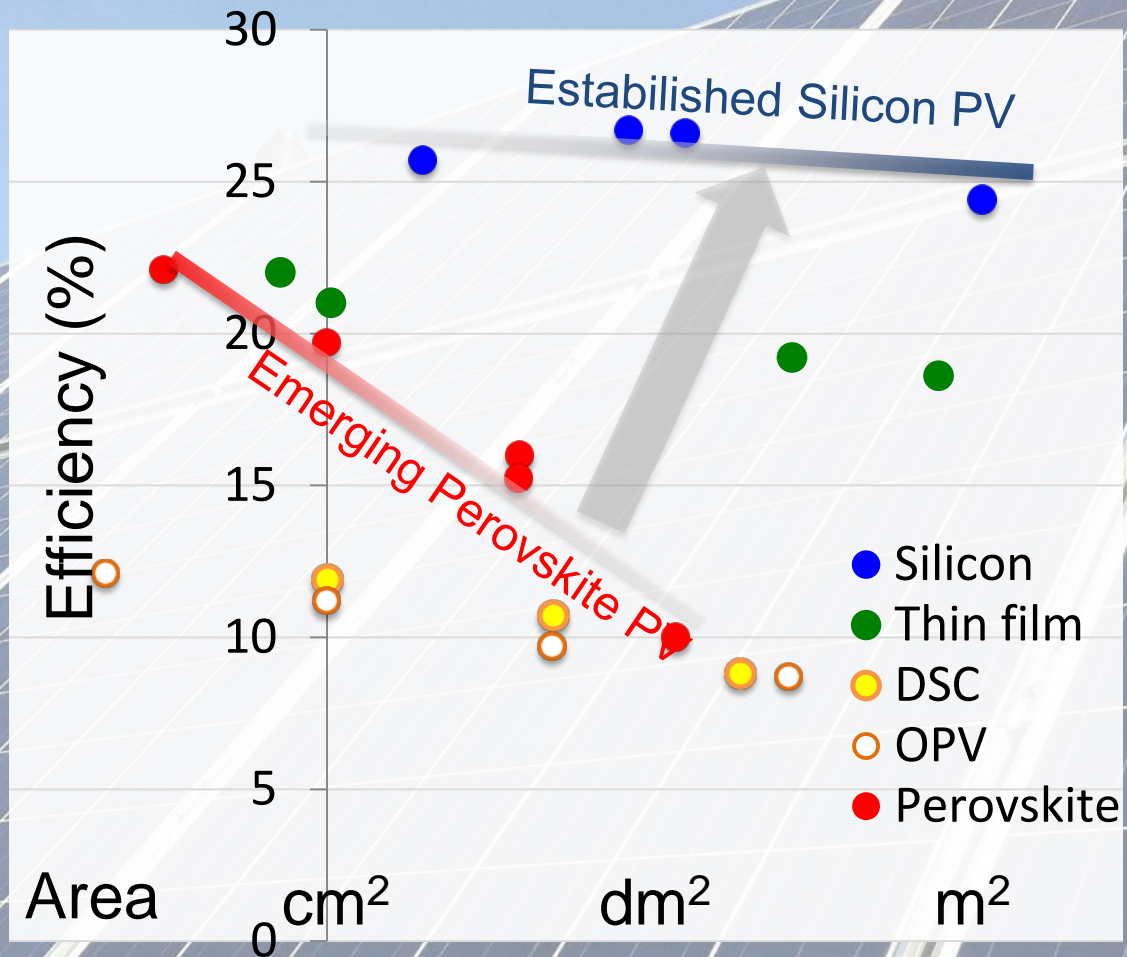
Eva Unger

Young Investigator Group Leader
“Hybrid Materials Formation and Scaling”
HySPRINT Innovation Lab Steering Committee

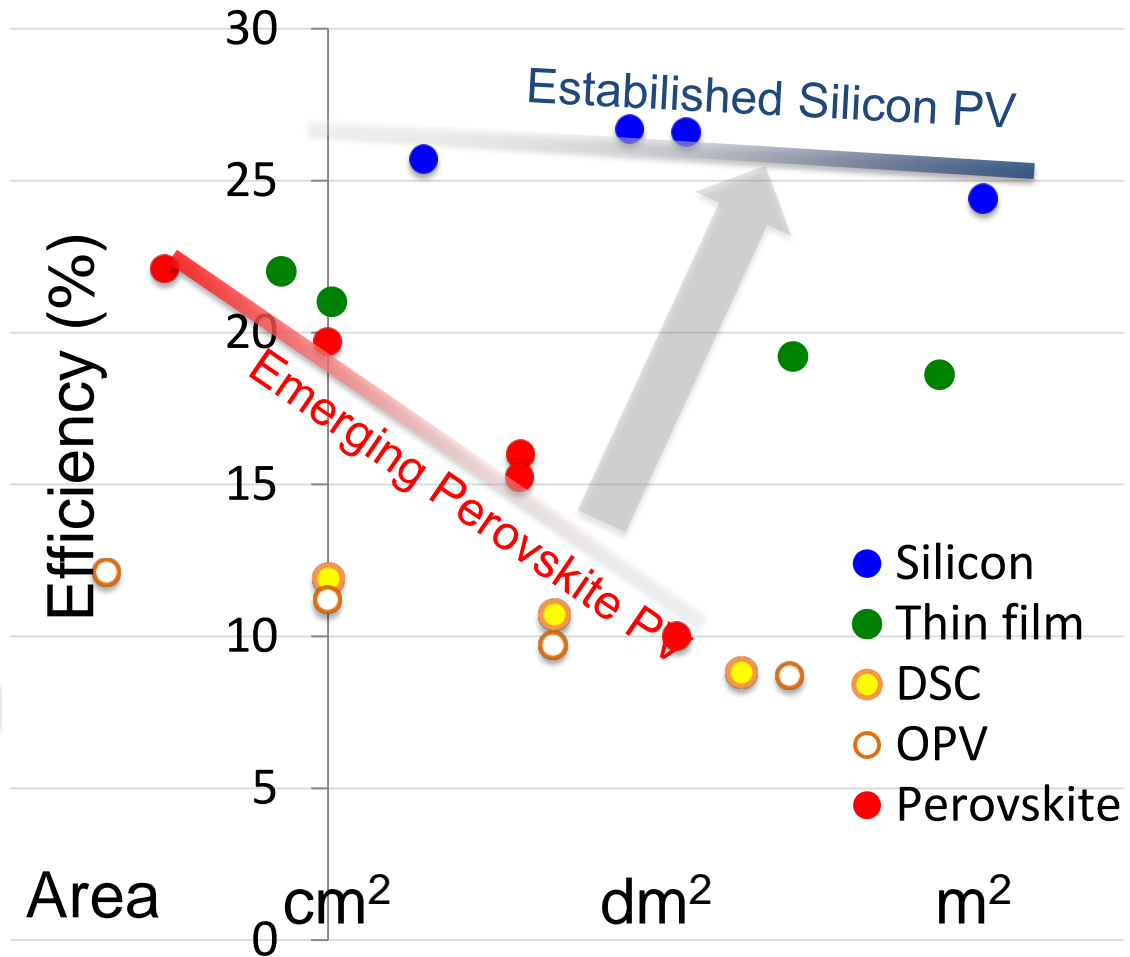
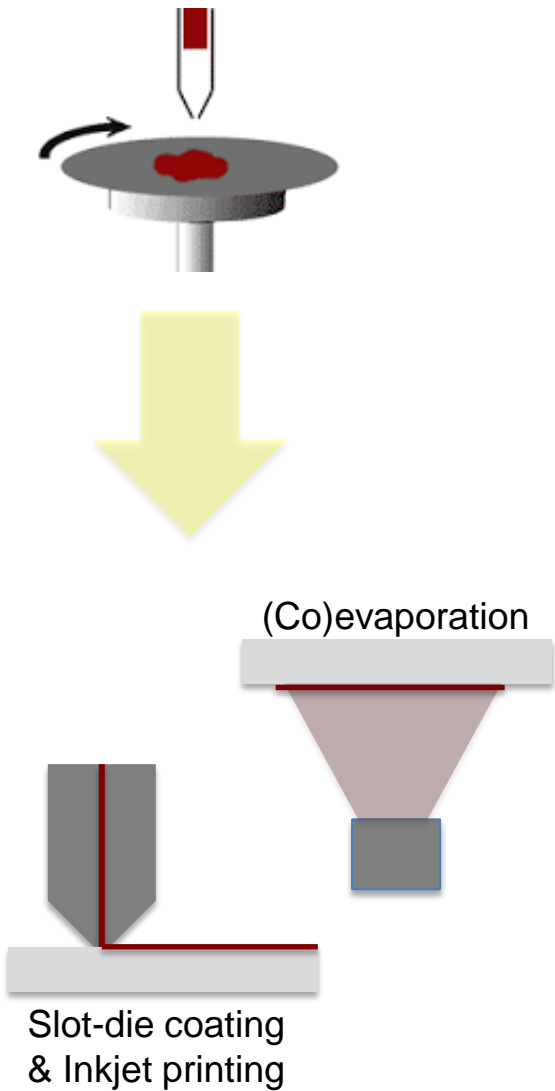
Affiliated with Lund University and Humboldt University Berlin



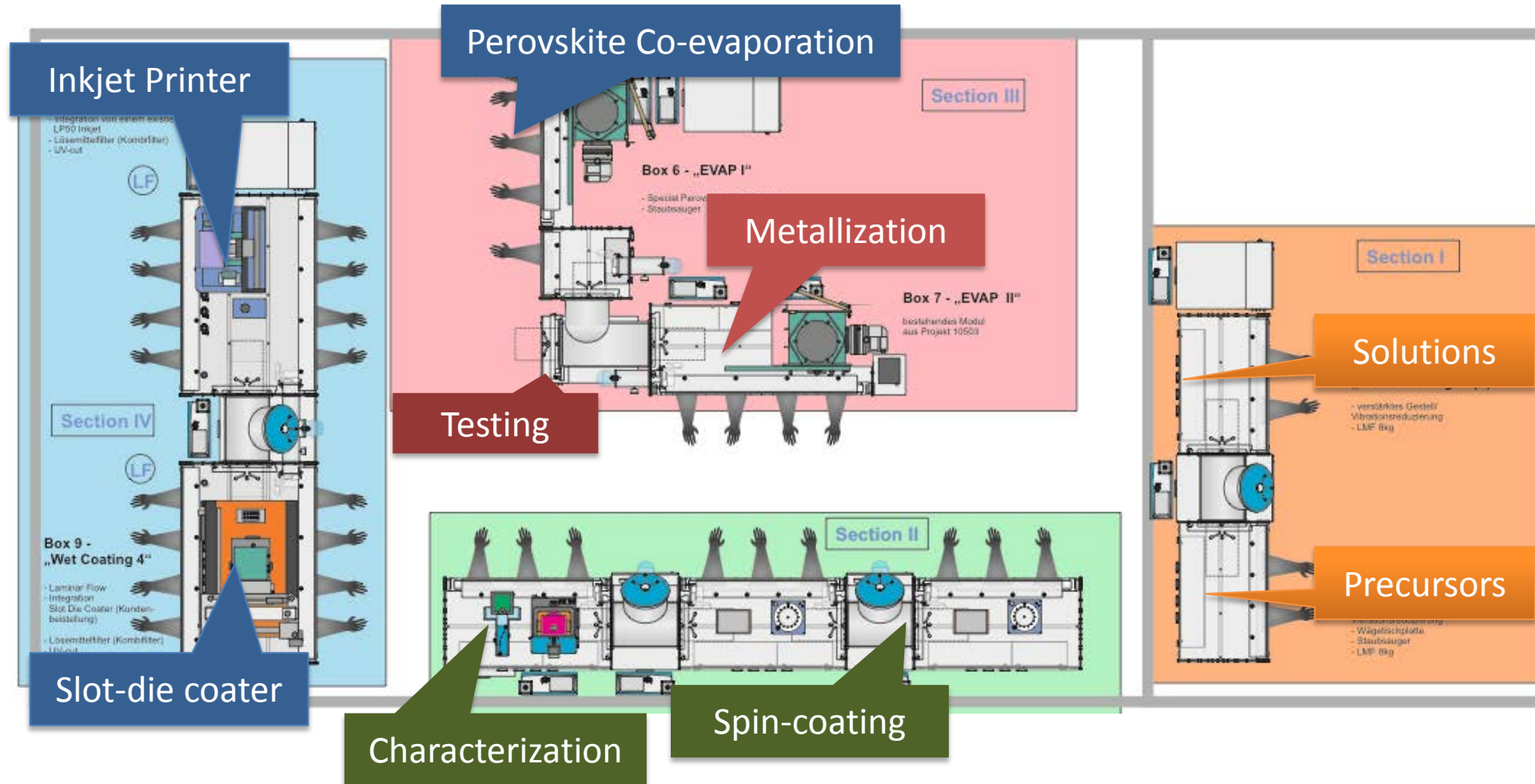


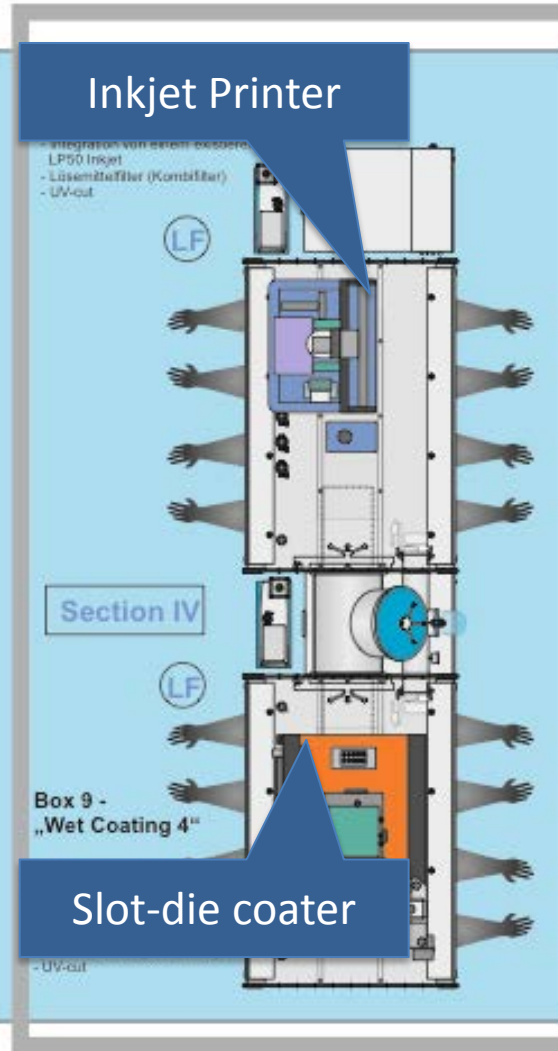


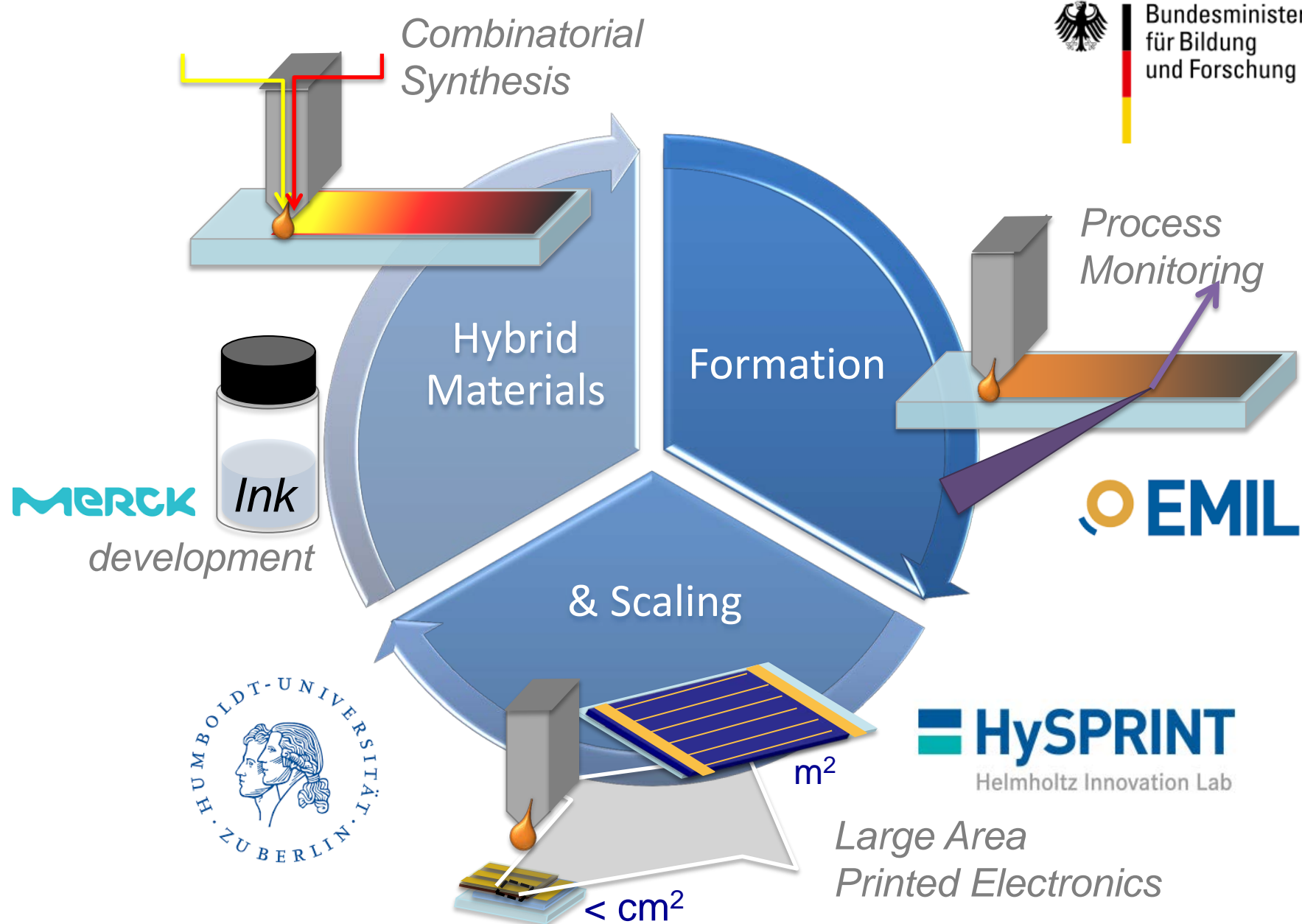
10% 156 cm² perovskite module from Solliance

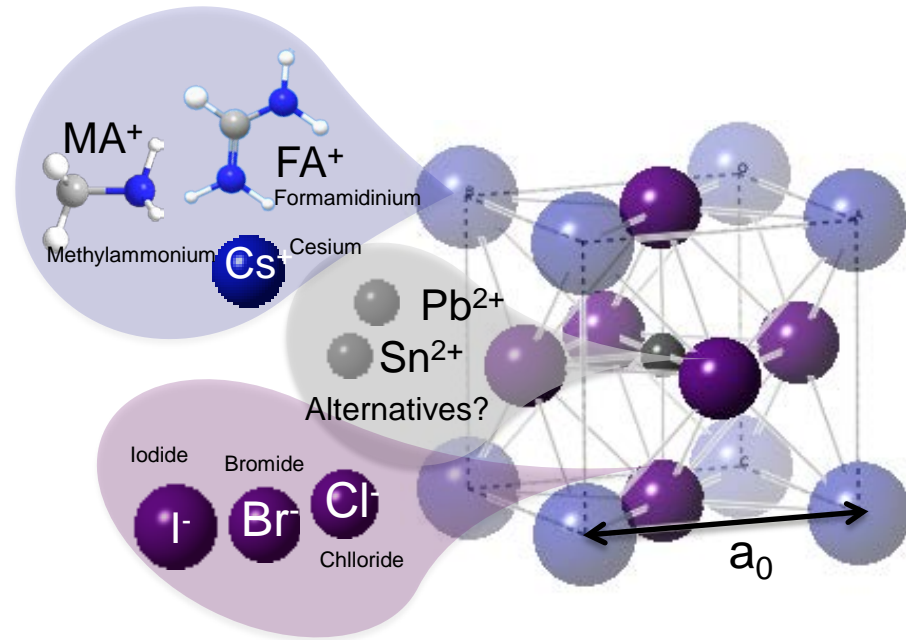


3 scalable deposition techniques for up to 100 cm²





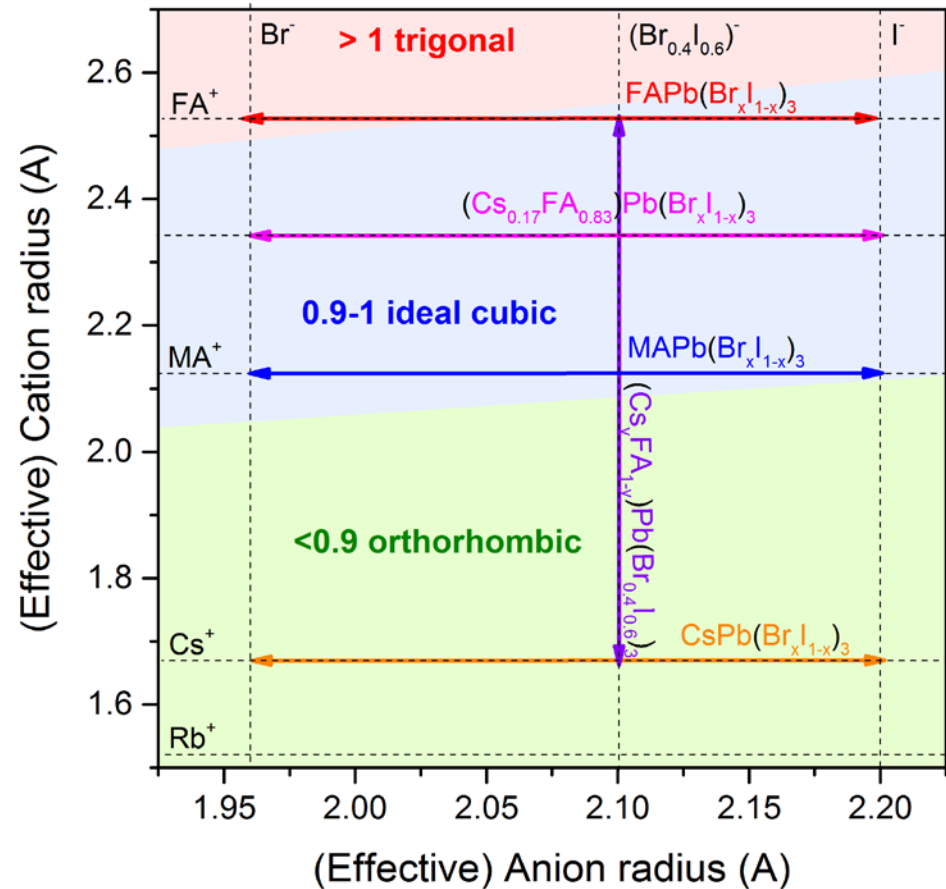


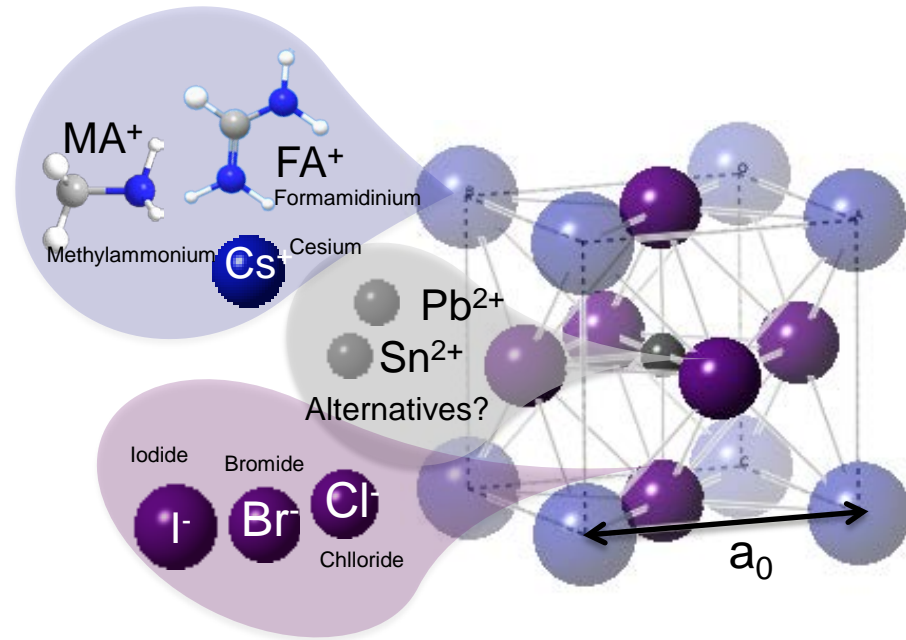


Ionic radii

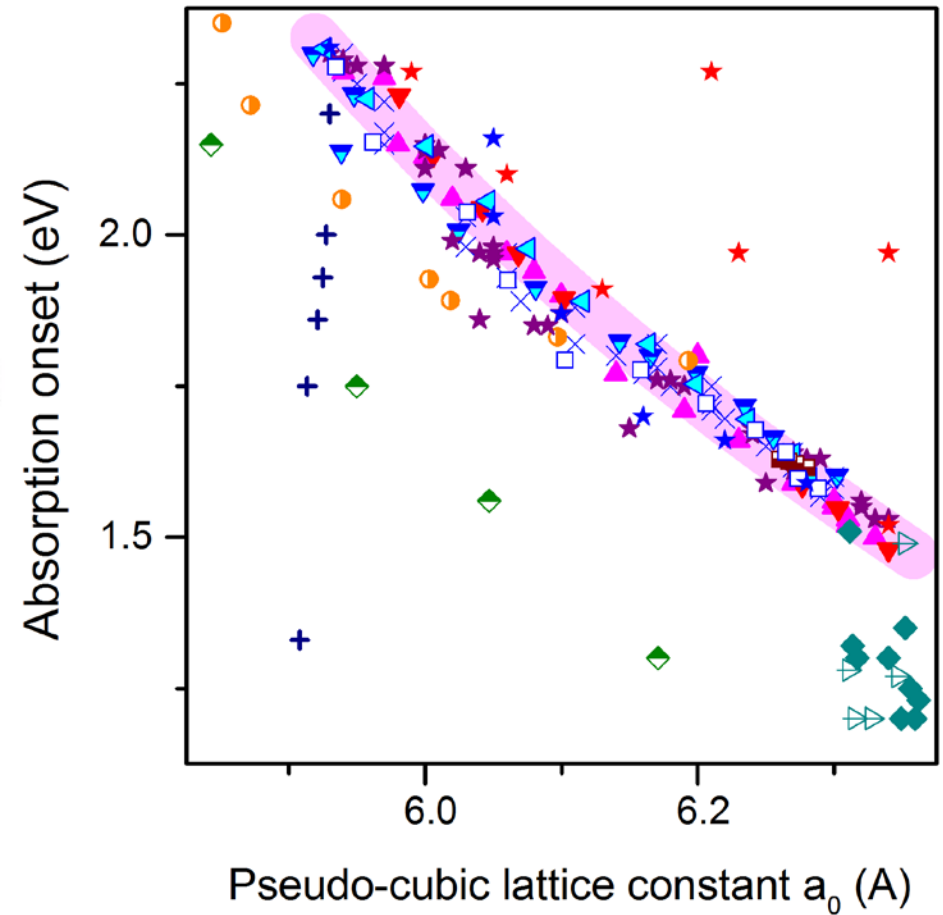
r_{Cs^+}	= 1.67 Å
r_{MA^+}	= 2.15 Å
r_{FA^+}	= 2.52 Å
$r_{Pb^{2+}}$	= 1.19 Å
$r_{Sn^{2+}}$	= 1.10 Å
r_{Cl^-}	= 1.81 Å
r_{Br^-}	= 1.96 Å
r_{I^-}	= 2.20 Å

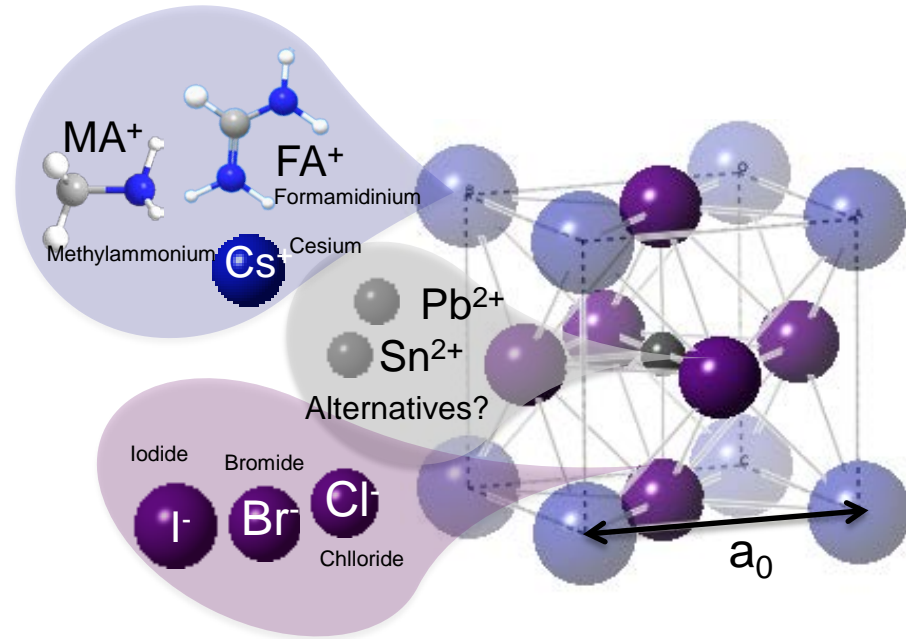
$$t = \frac{(r_{A_{eff}} + r_{X_{eff}})}{\sqrt{2}(r_{Pb^{2+}} + r_{X_{eff}})}$$



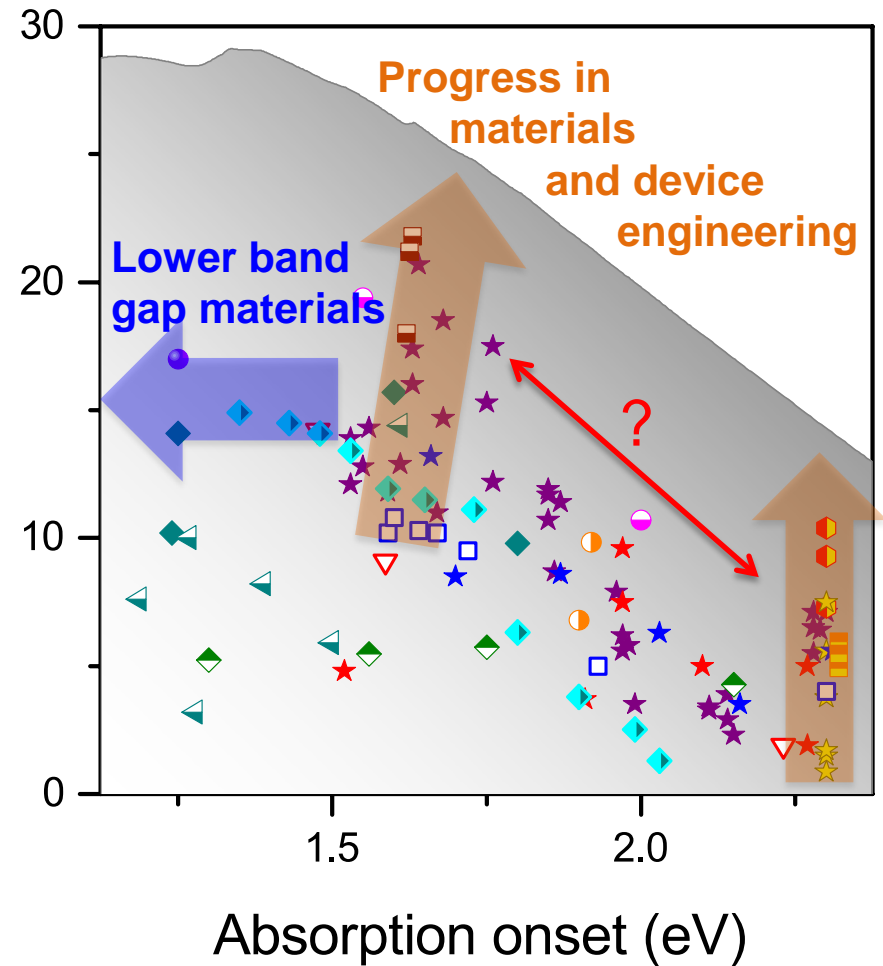


Pb-based perovskites:
 Absorption onset depends
 on lattice parameter



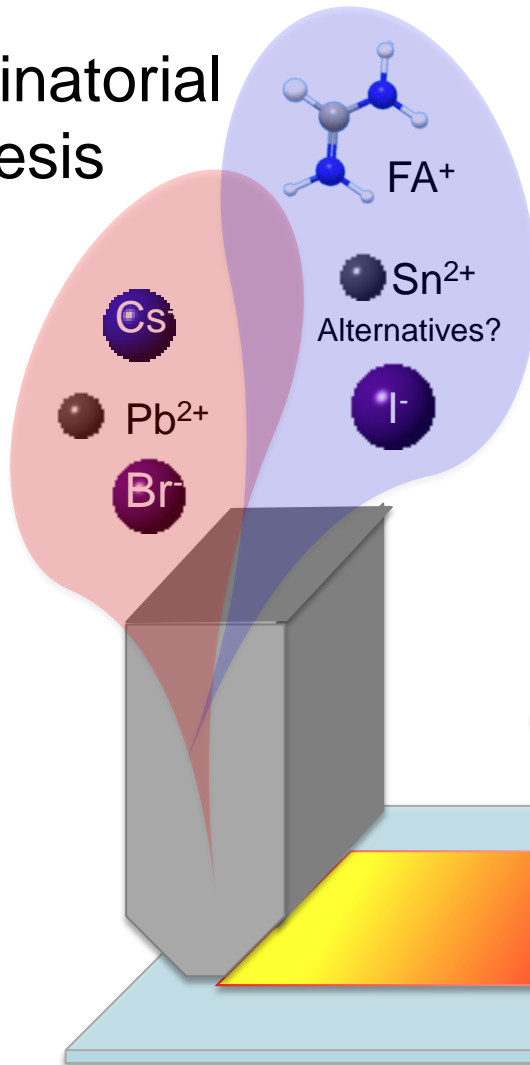


Comparison of large data sets allows appreciation of general trends and limitations.



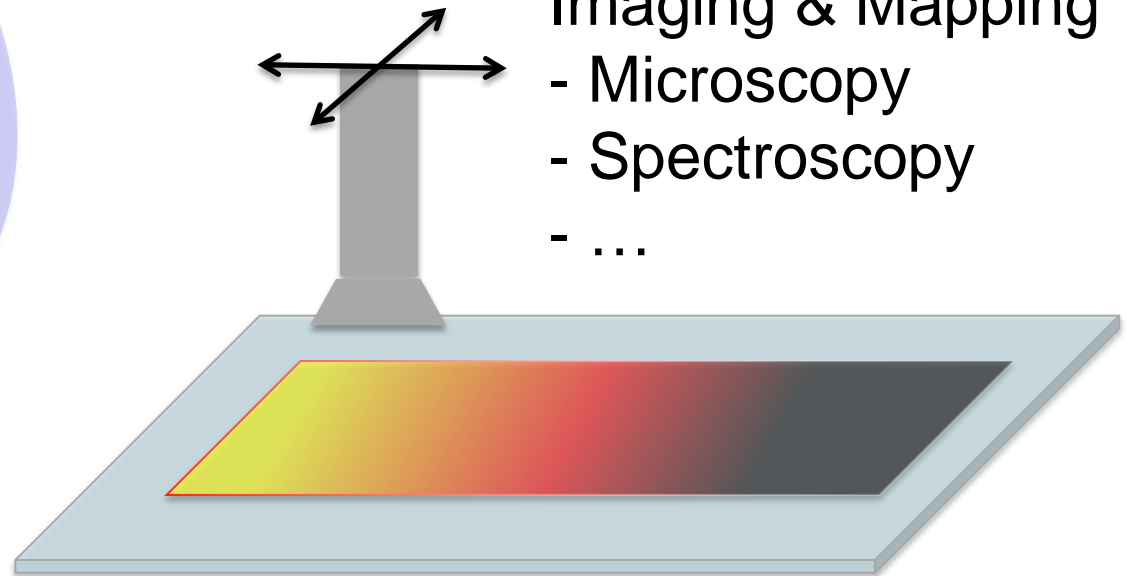


Combinatorial Synthesis



Imaging & Mapping

- Microscopy
- Spectroscopy
- ...

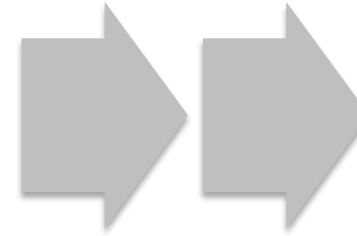


1) Ink development

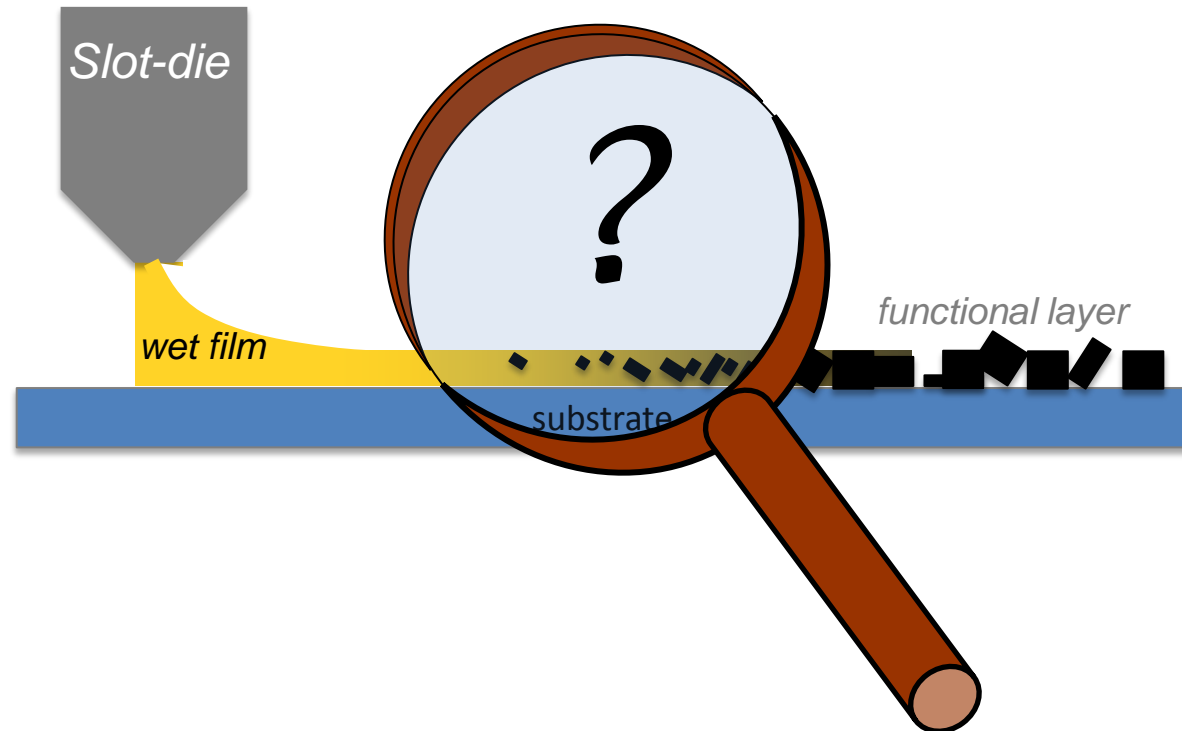
- precursors
- solvents
- additives

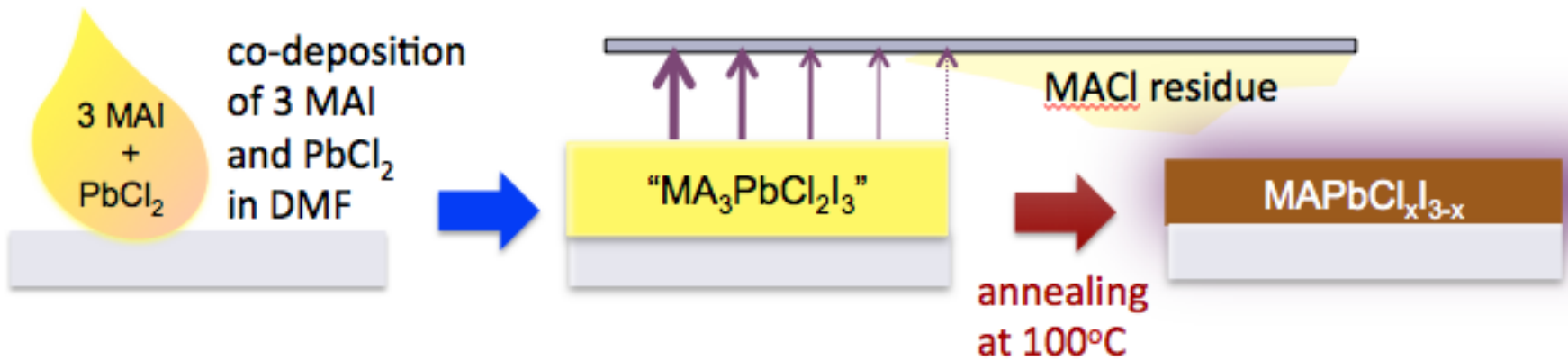
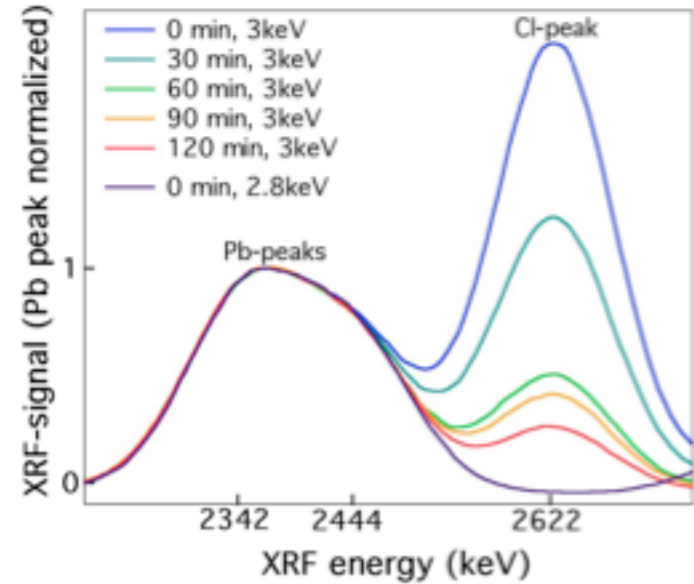
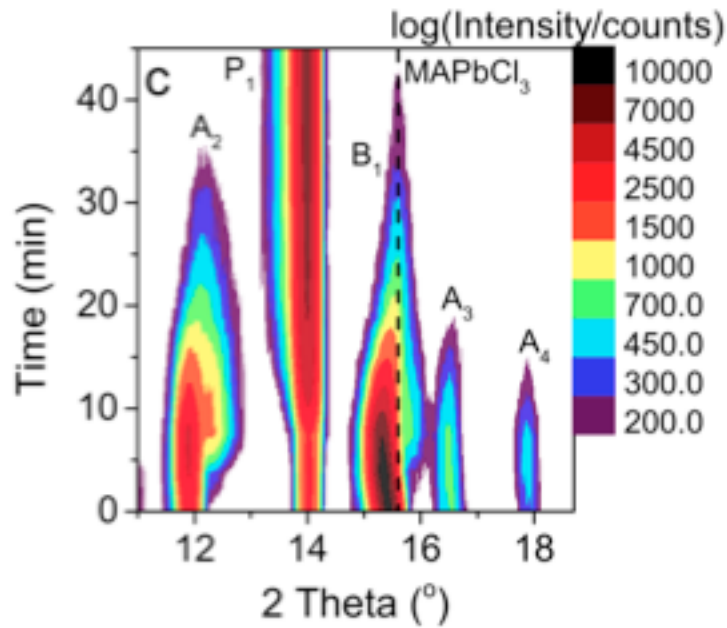
2) Process optimization

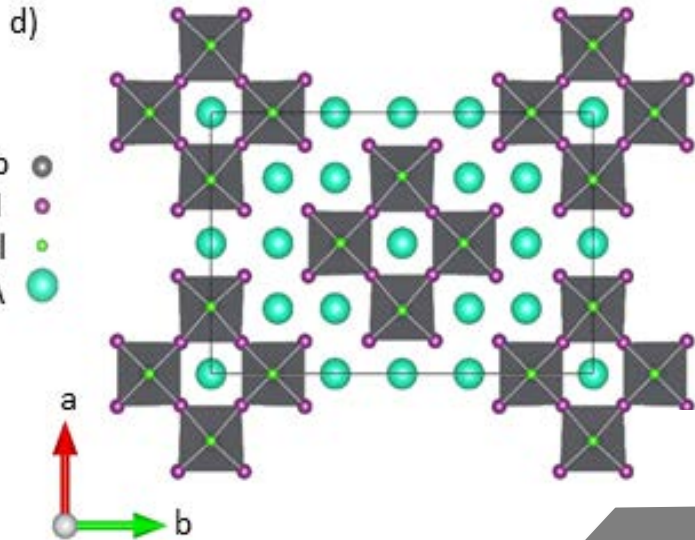
- process parameters
- in-line post-treatment



**High quality
perovskite
layers?**

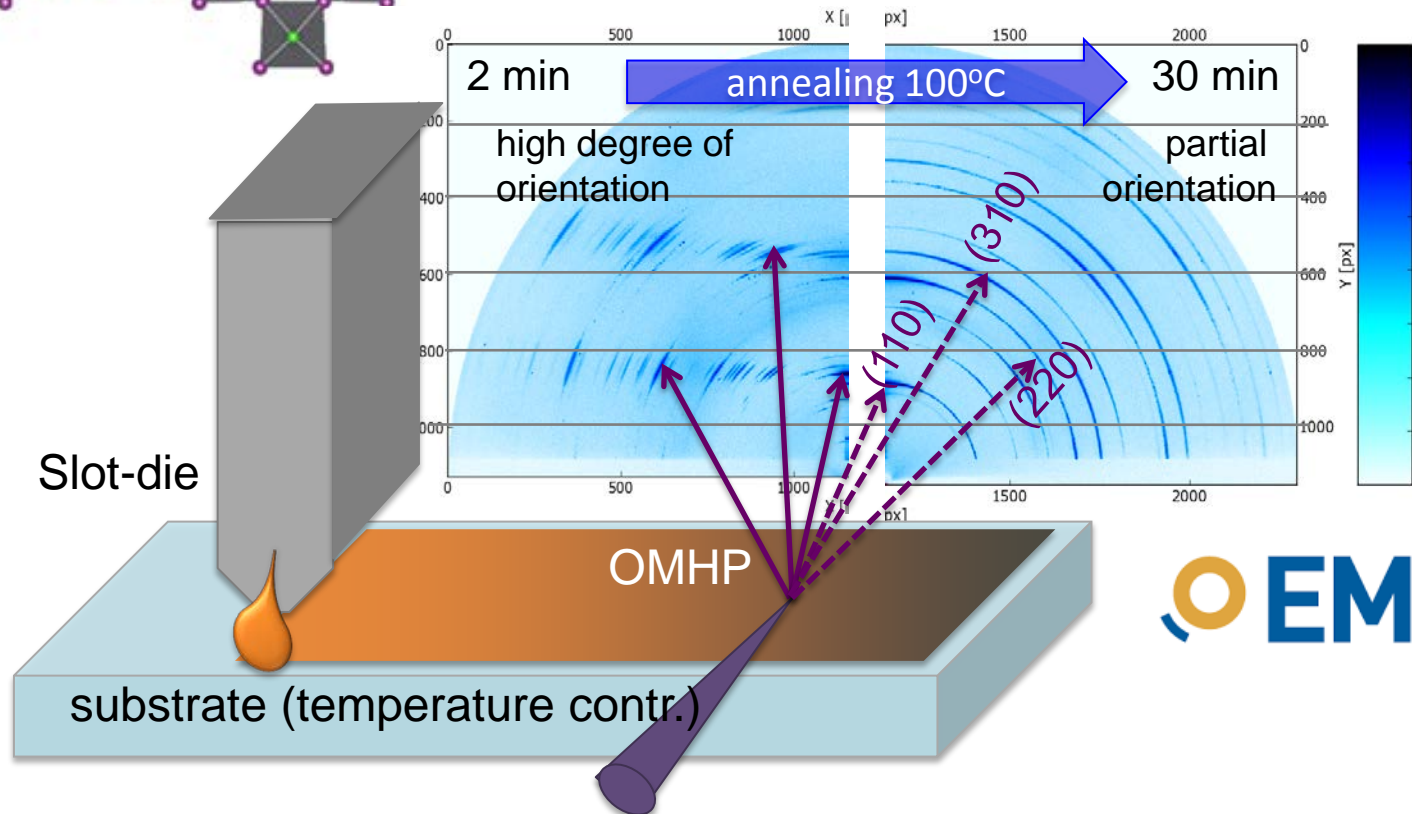




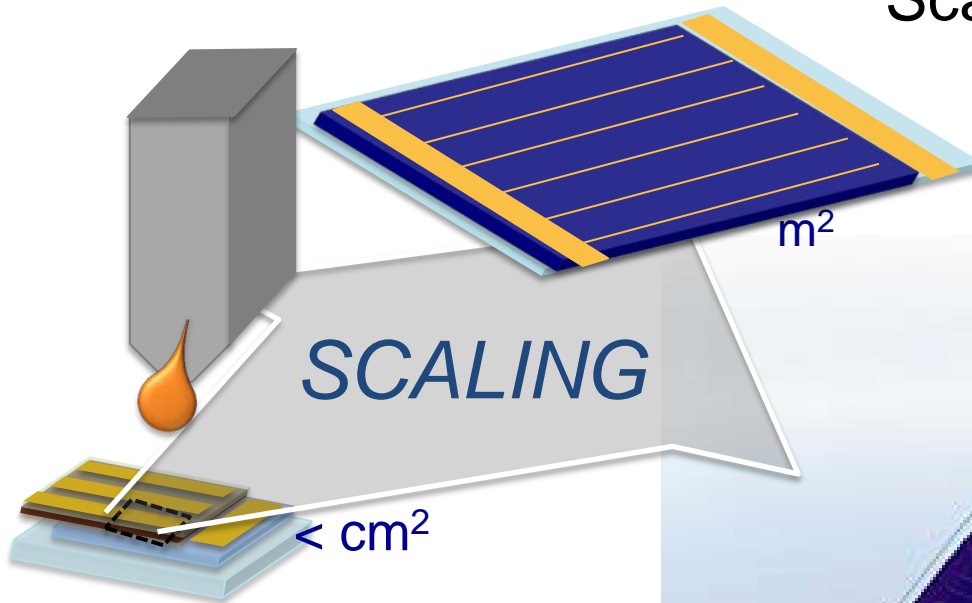


Data beamtime 2014 at SSRL¹

NOW we know the structure of the intermediate phase!²



Scaling devices to larger areas!



Yes, we can (too)!

