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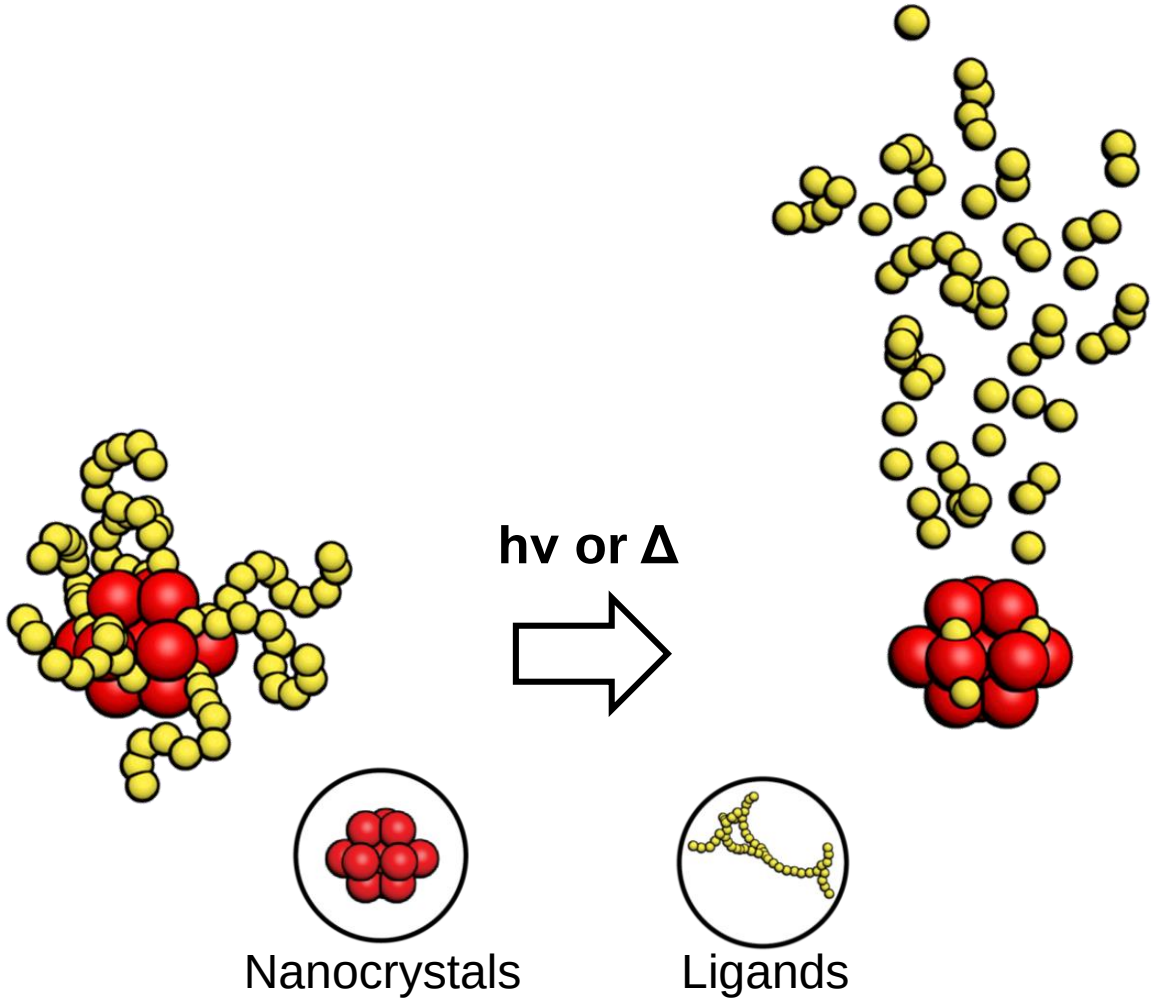
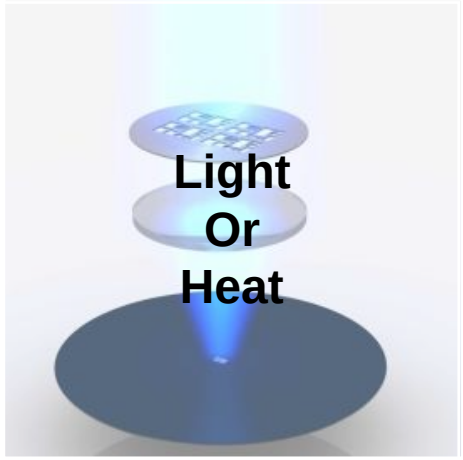
PHOSPHORS & QUANTUM DOTS INDUSTRY FORUM

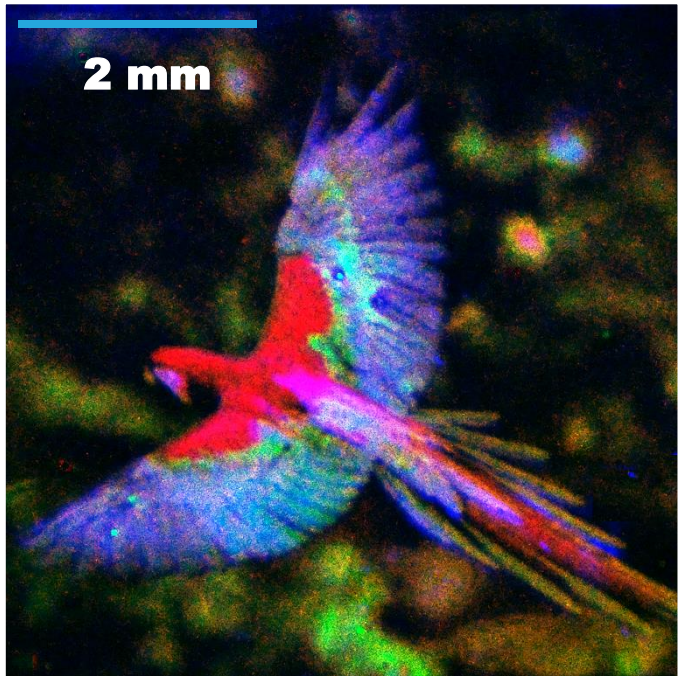
Engineering high resolution down converters using dense QD films

Yu Kambe CEO, Co-founder

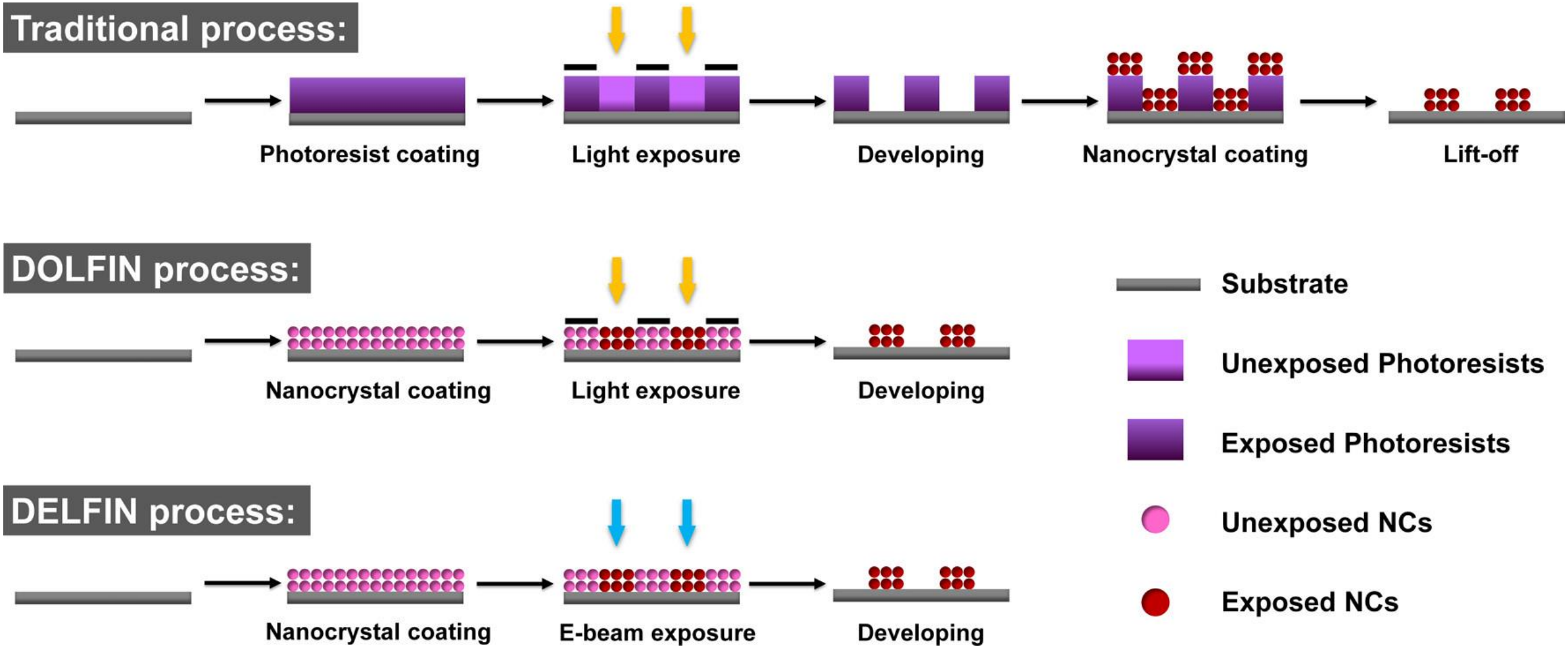
Technology – photodegradable ligands no resin matrix required







Wang, Y., Fedin, I., Zhang, H., & Talapin, D. V. (2017). Science, 357(6349), 385-388.
Wang, Y., Pan, J. A., Wu, H., & Talapin, D. V. (2019). ACS nano, 13(12), 13917-13931.

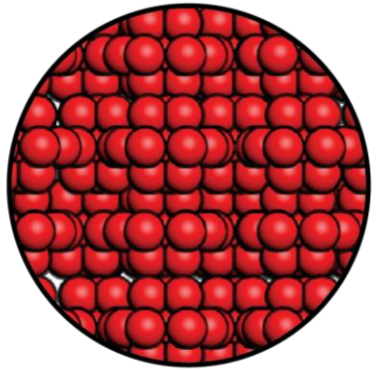


Wang, Y., Pan, J. A., Wu, H., & Talapin, D. V. (2019). ACS nano, 13(12), 13917-13931.

NanoPattern can photopattern dense QD films

70%*

Solid Volume



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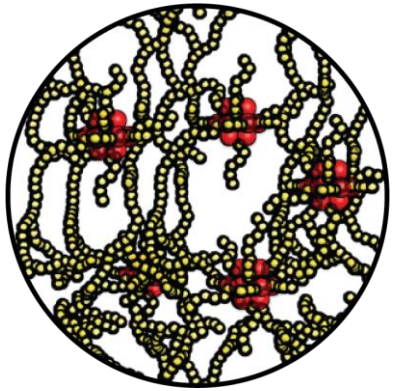
40%

Solid Volume

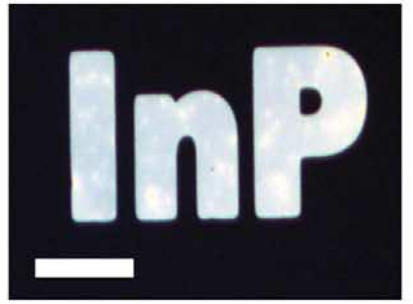


Conventional Approach:
Nanocrystals in organic resin

*Volume fraction for NanoPattern based on high packing limitation of spheres ~74%.

NanoPattern is
not a QD manufacturer
the technology can work with anyone's QD (and other nanoparticles)

InP/ZnS	Au
CdSe/ZnS	FePt
Perovskites	IGZO
TiO_2	ZrO_2



Wang, Y., Fedin, I., Zhang, H., & Talapin, D. V. (2017). Science, 357(6349), 385-388.

Micro displays

Unmet needs

<5 µm

Lateral resolution

High QY

At 50-150 ºC temperatures
And high brightness

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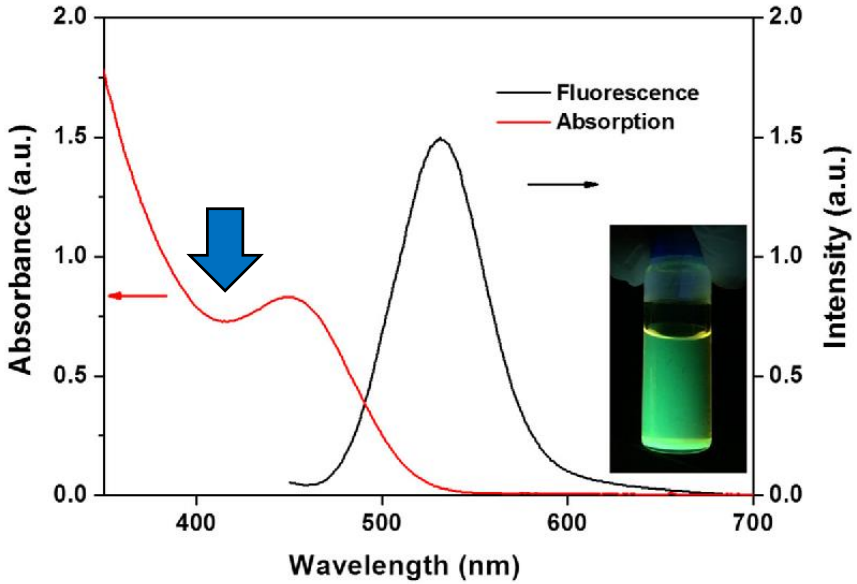
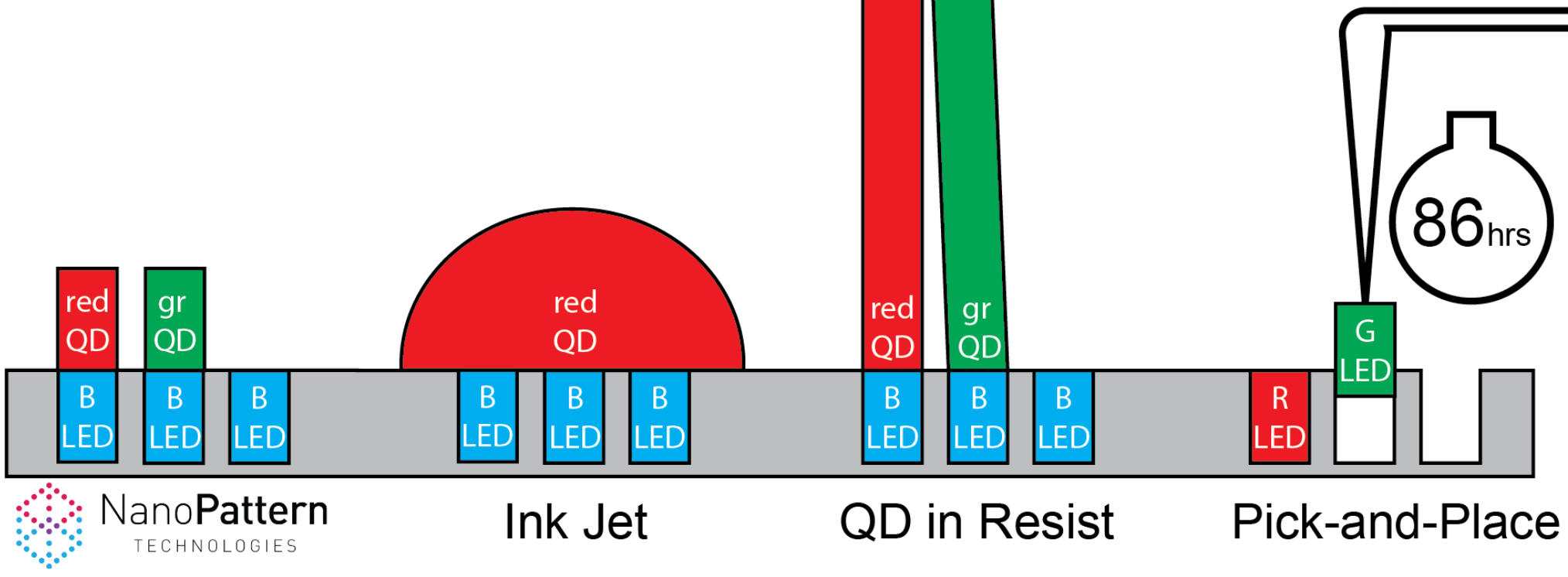
Comparison

Of patterning methods





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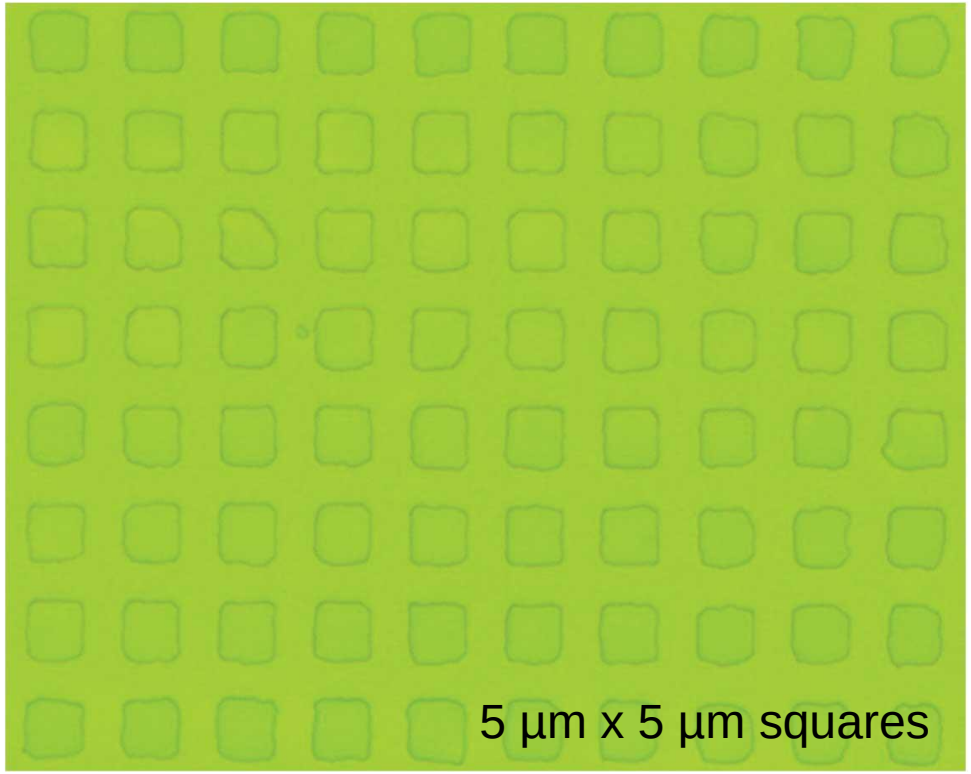

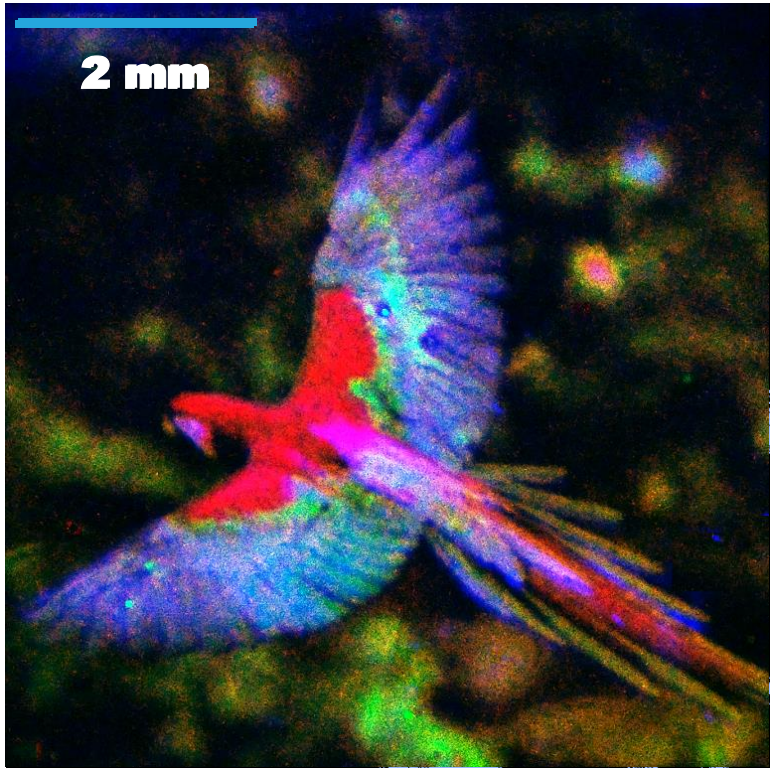

5 µm lateral resolution

Multi patterning

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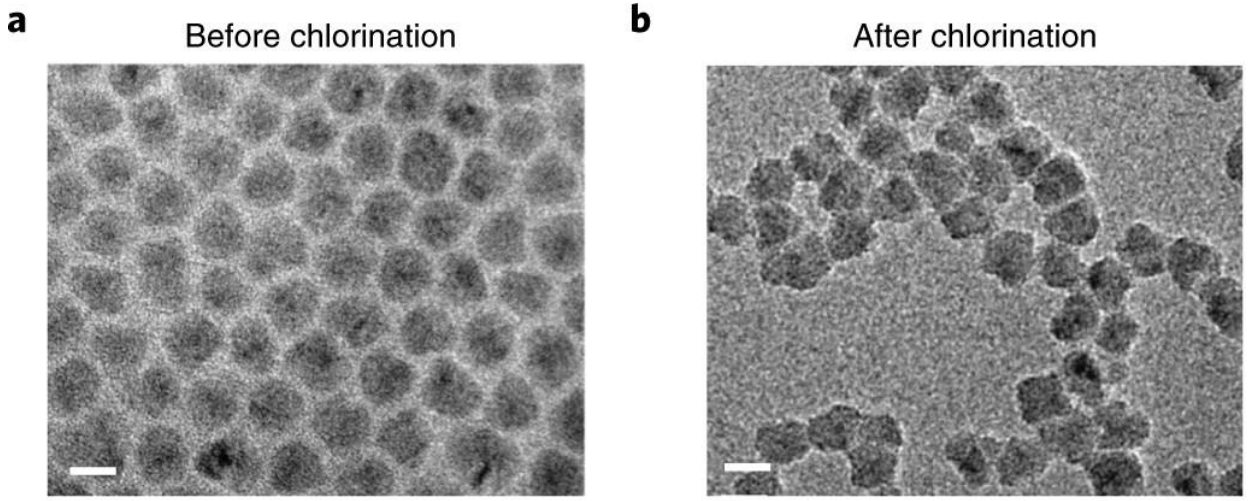
TOPIC

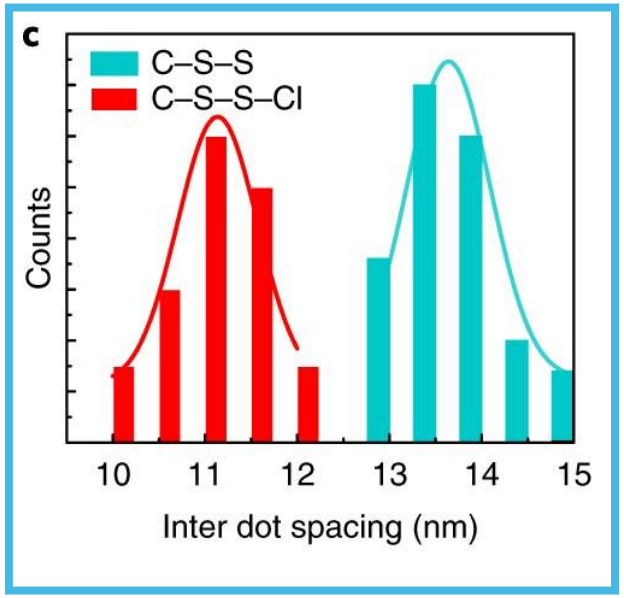
Preserving QY in dense films

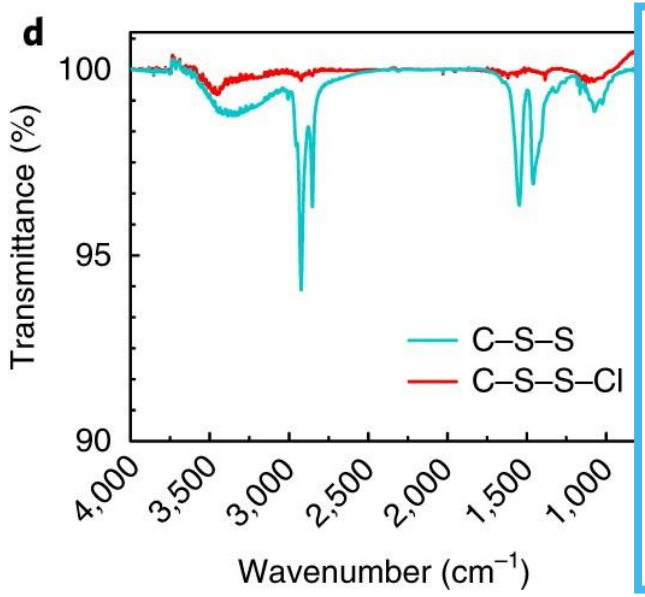


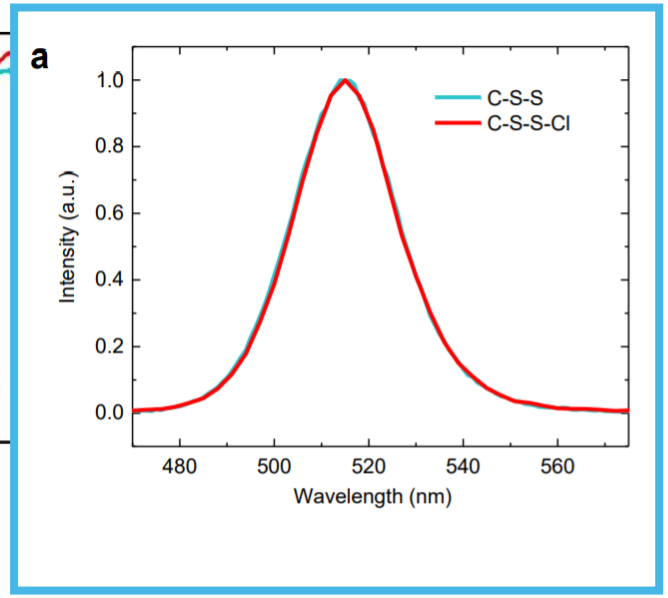
Currently, we can preserve

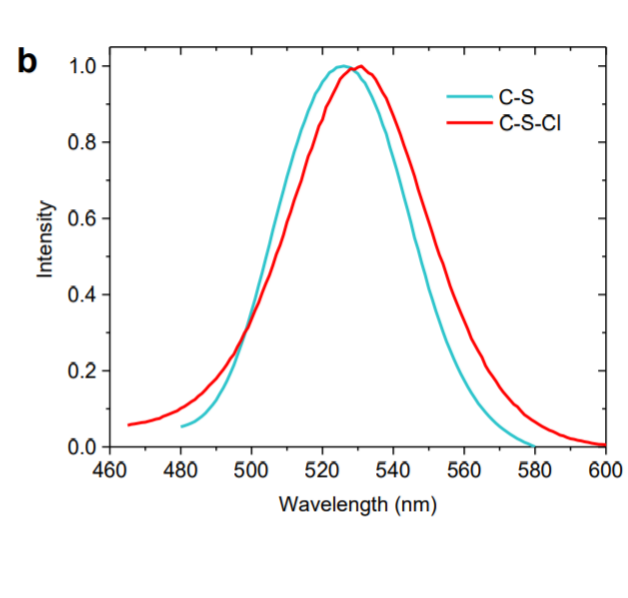
60%

Of solution QY in film
But we have a plan









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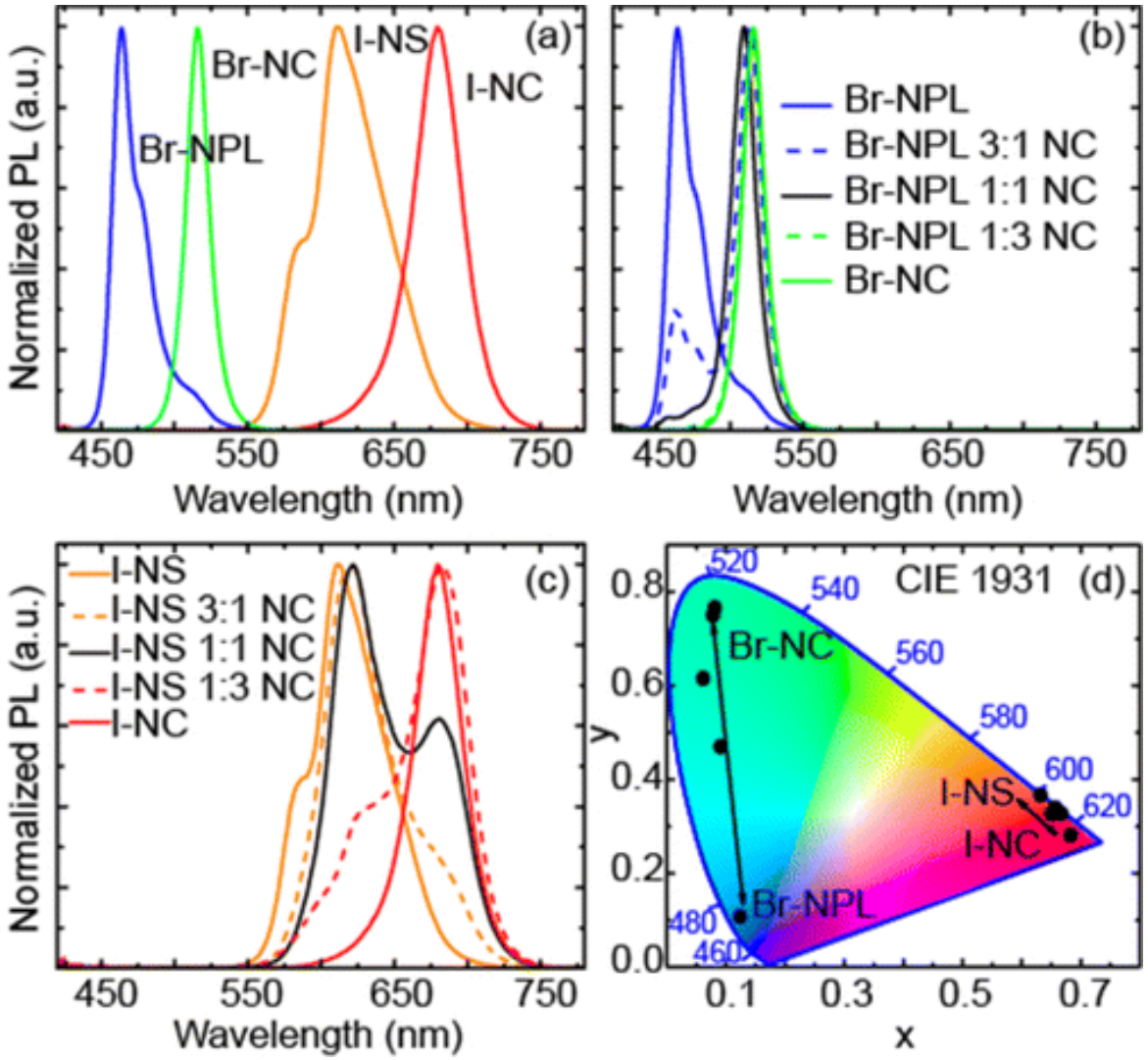
Li, X., Zhao, Y. B., Fan, F., Levina, L., Liu, M., Quintero-Bermudez, R., ... & Hoogland, S. Nature Photonics, 12(3), 159-164. 2018.

Perovskite QDs may be

Ideal

For dense downconverter films



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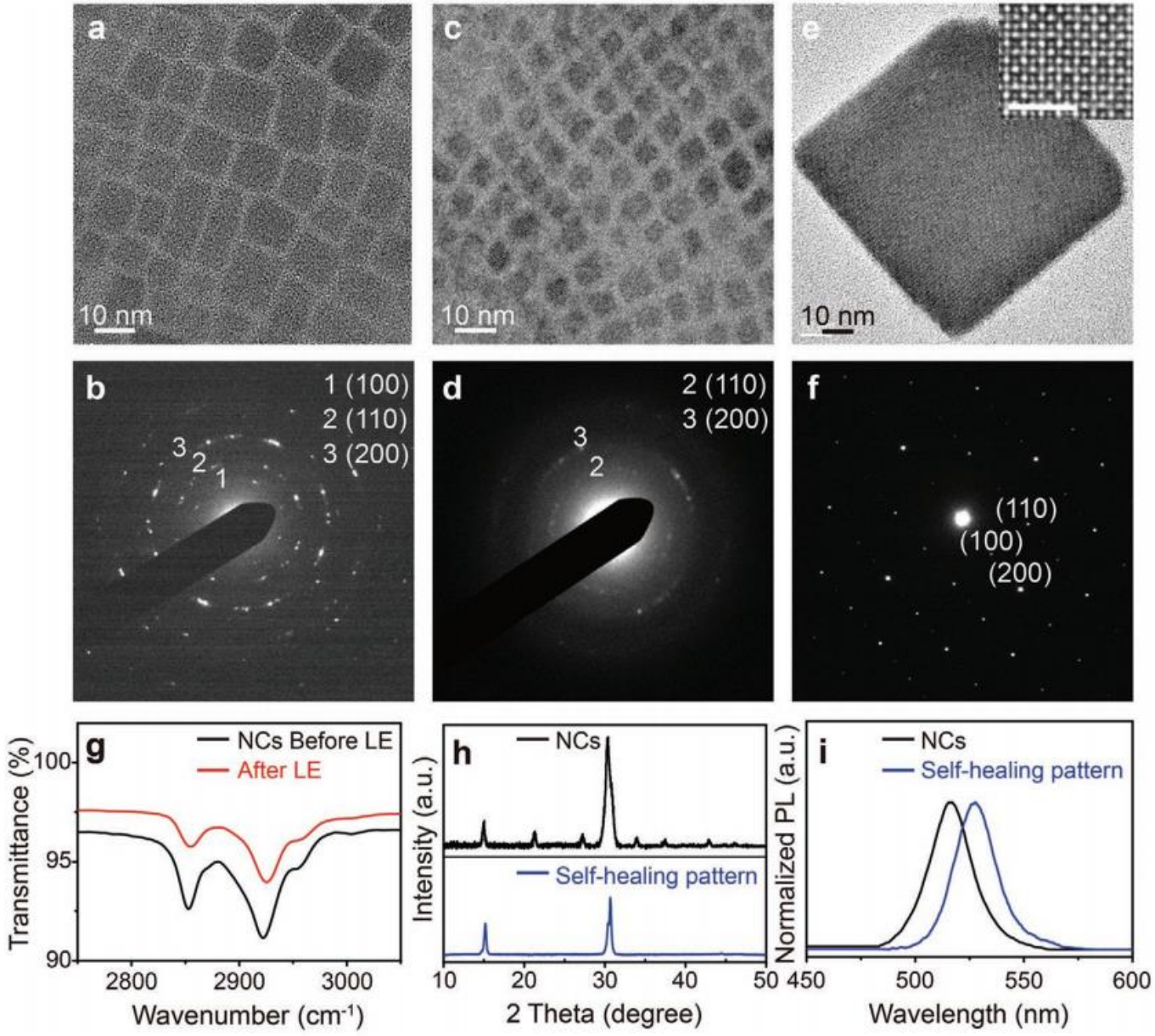
Palazon, F., Di Stasio, F., Akkerman, Q. A., Krahne, R., Prato, M., & Manna, L. Chemistry of Materials, 28(9), 2902-2906. 2016.

Bulk

Films still emit



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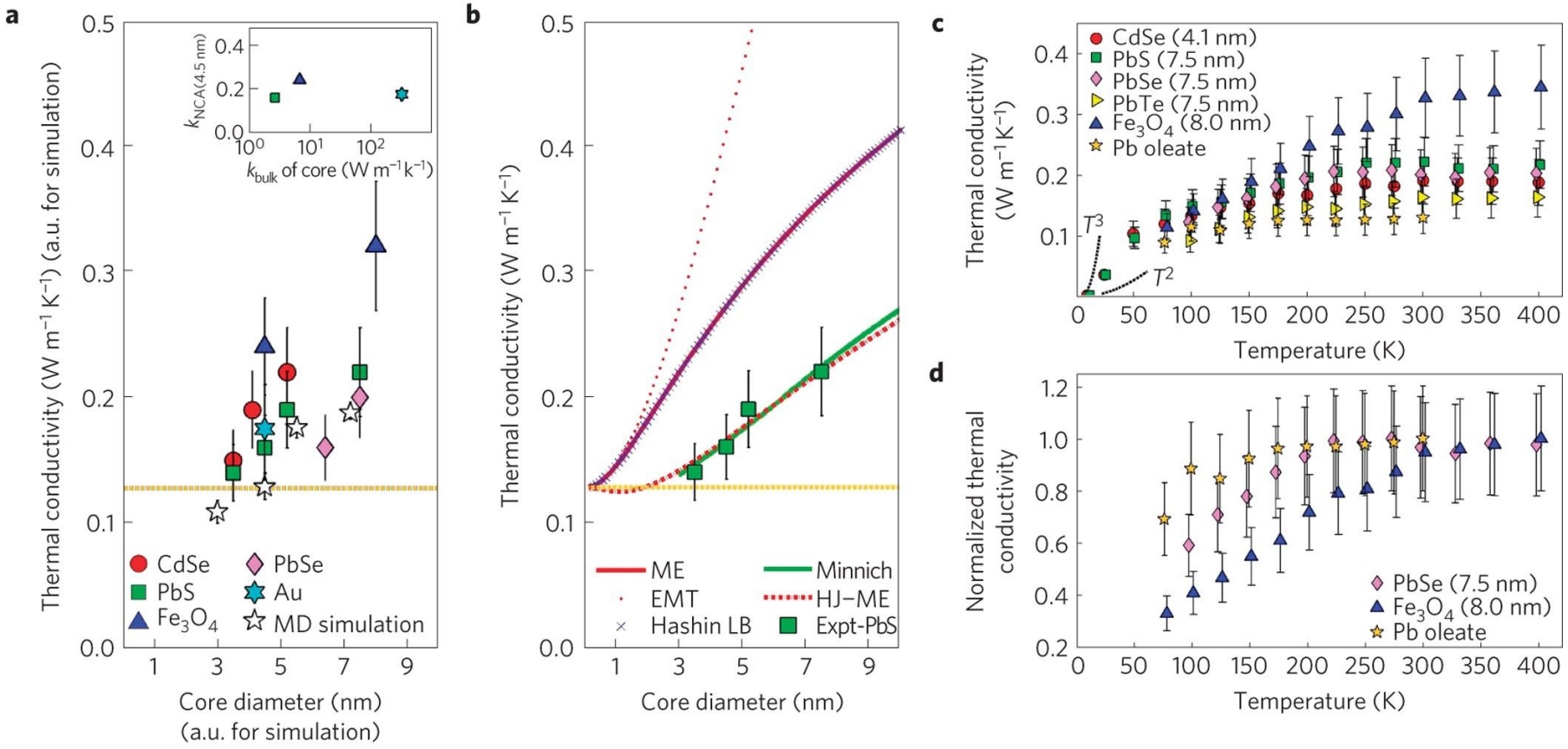
Xing, D., Lin, C. C., Ho, Y. L., Kamal, A. S. A., Wang, I. T., Chen, C. C., ... & Delaunay, J. J. (2020). *Advanced Functional Materials*, 2006283.

Thermal conductivity can be increased by

3x

Through ligand and volume control



Ong, W.-L., Rupich, S. M., Talapin, D. V., McGaughey, A. J. H. & Malen, J. A. Nat. Mater. 12, 410 (2013).

Liu M, Ma Y, Wang RY. ACS Nano. 22;9(12):12079-87 (2015).

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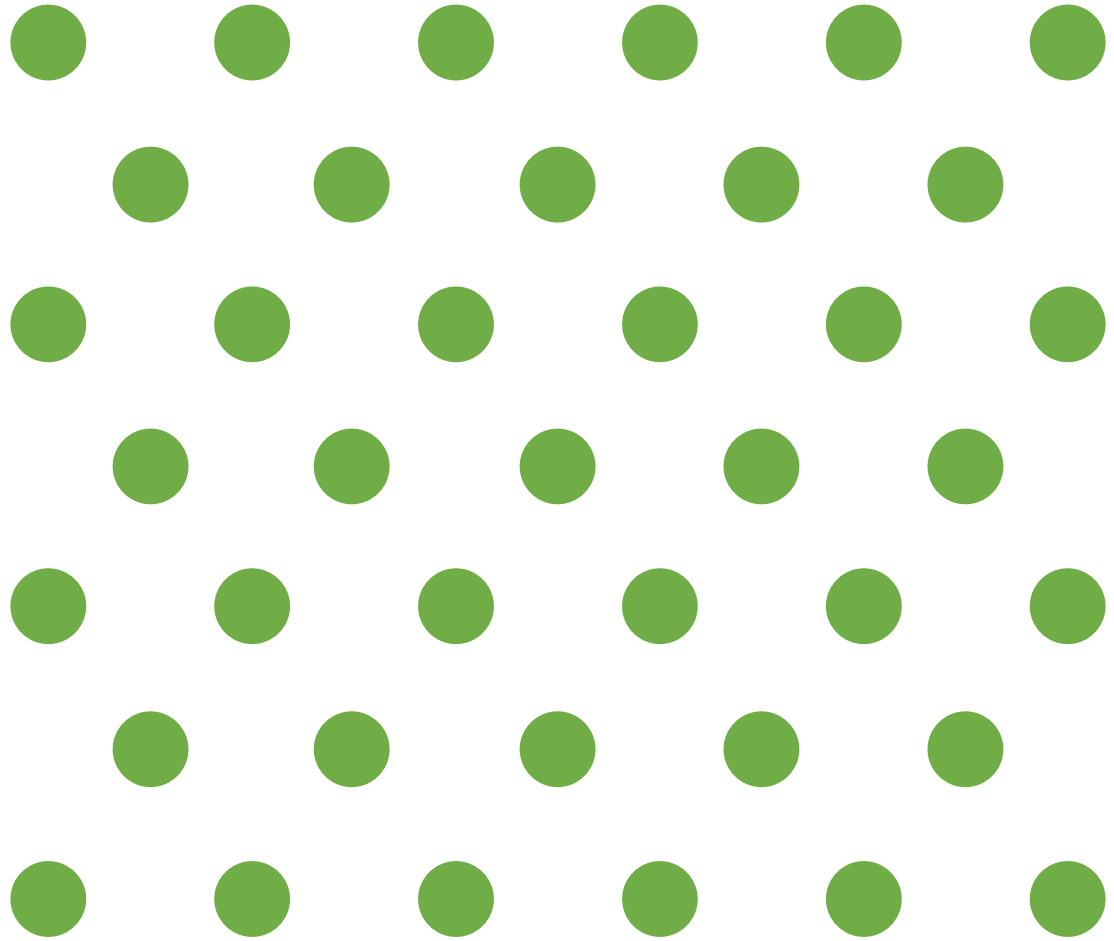
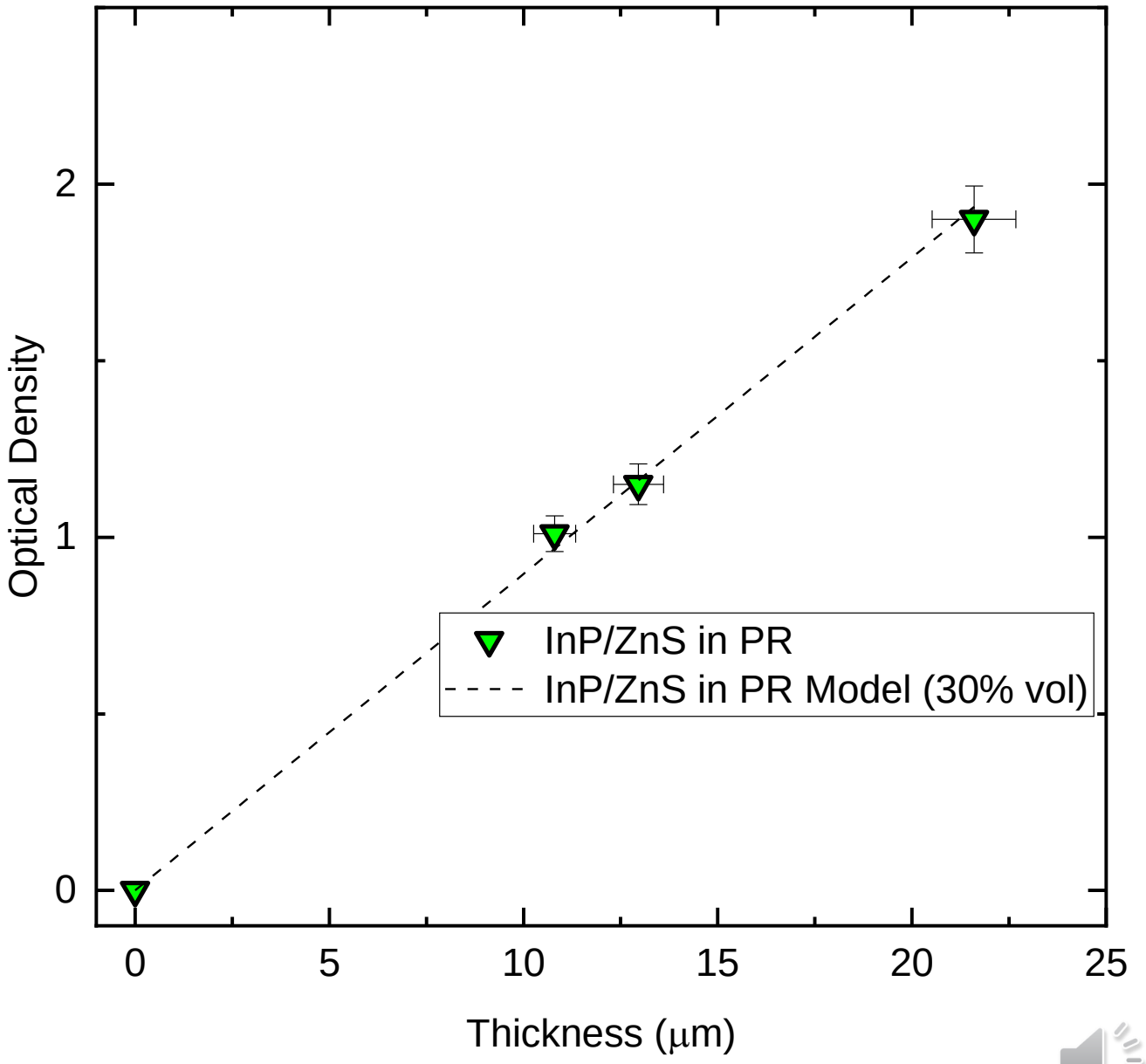
TOPIC

Optical Density





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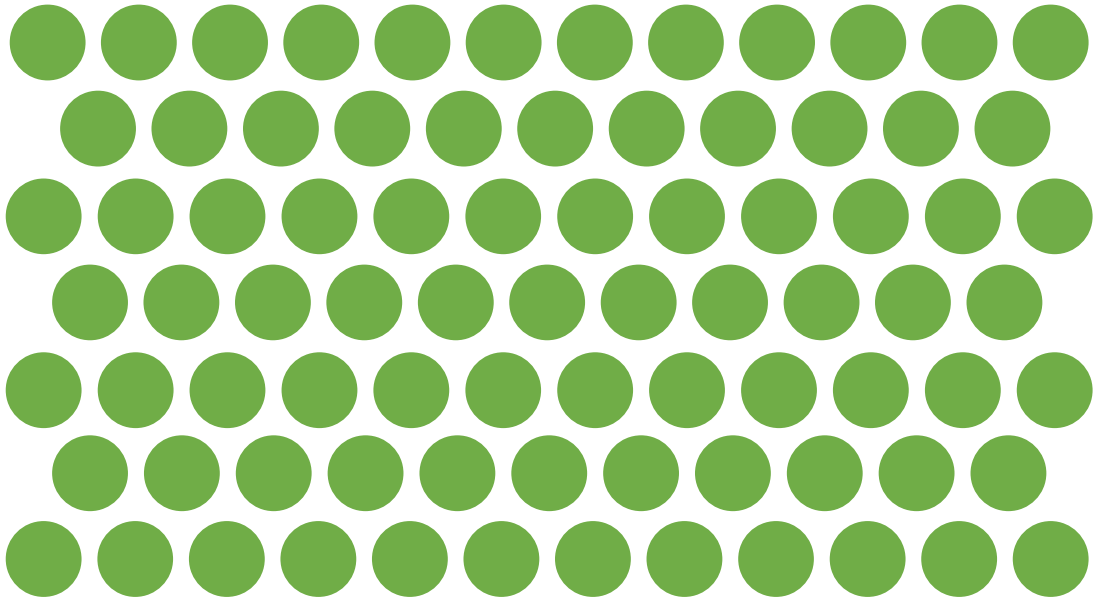
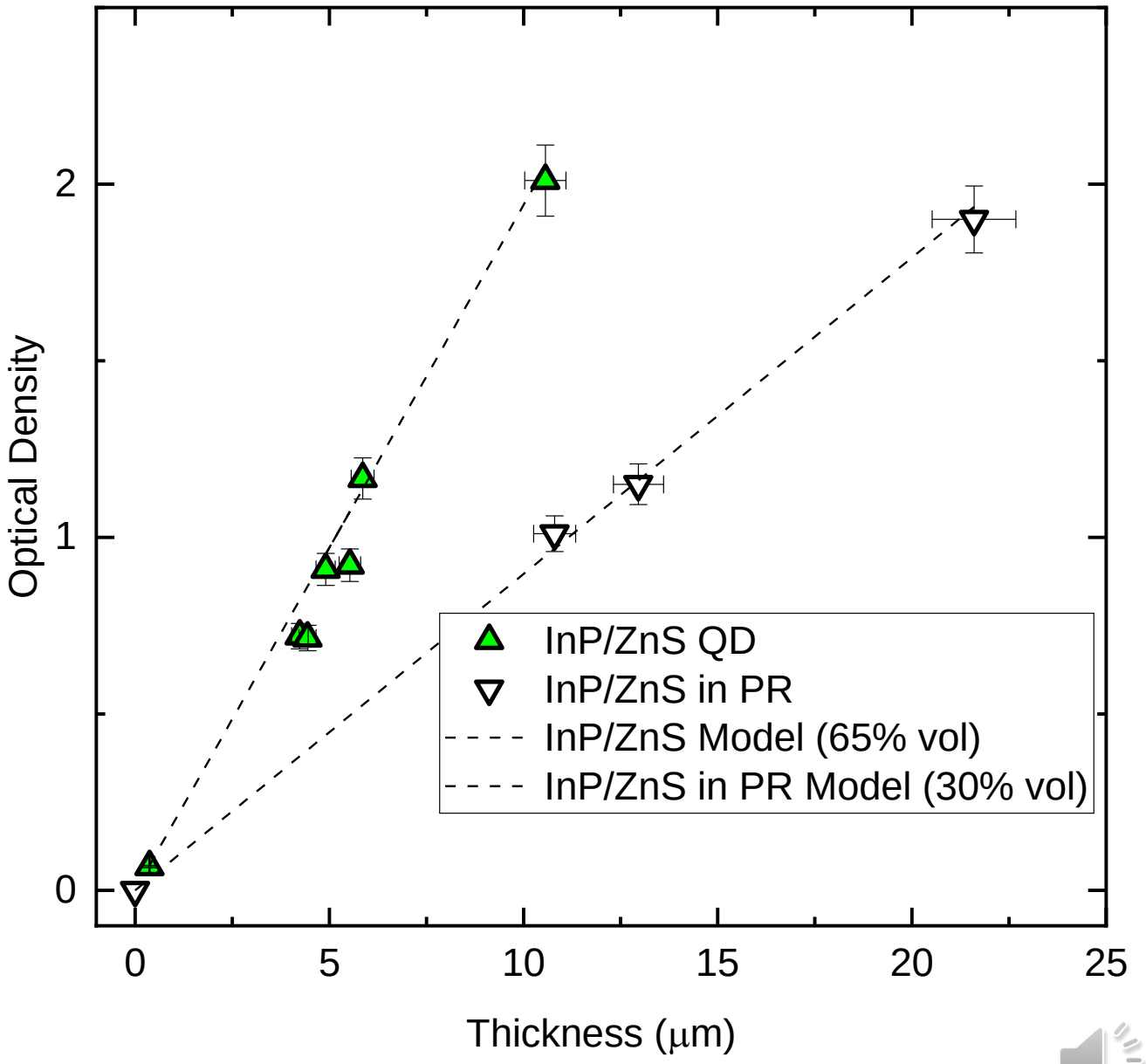
Model: Osinski, J. and Palomaki, P. SID Symposium Digest of Technical Papers , 50, 1, 34-37, (2019)





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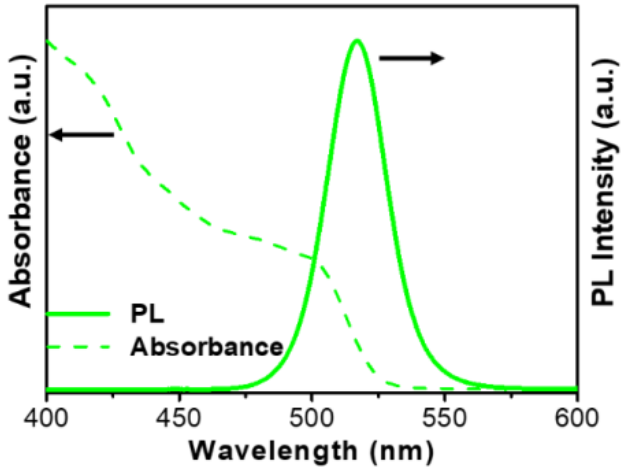

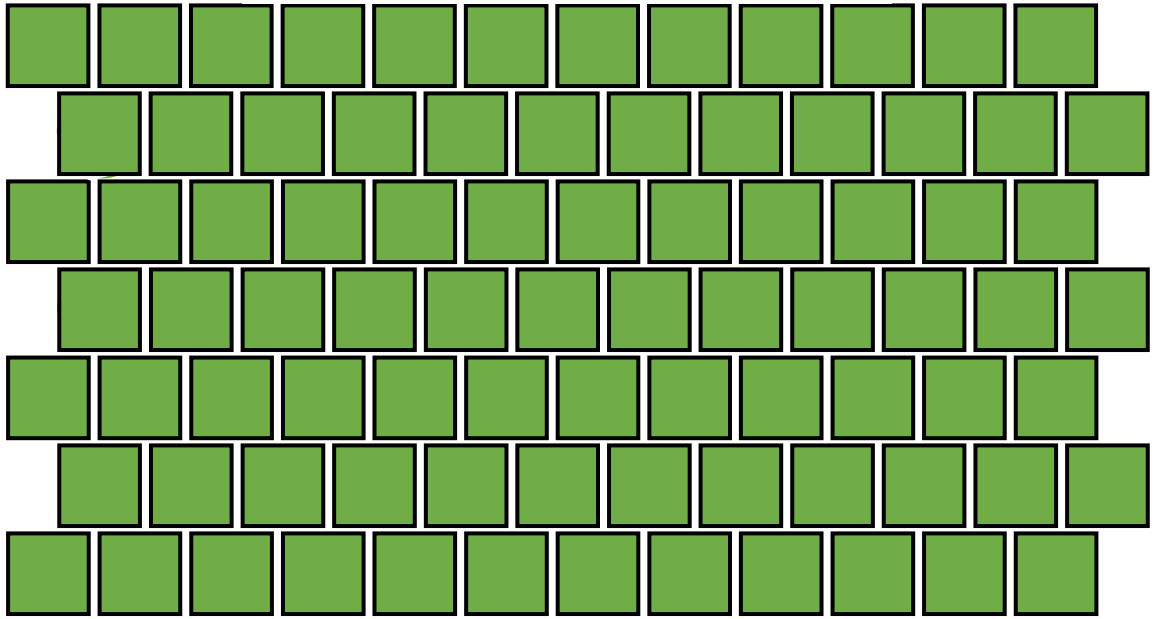

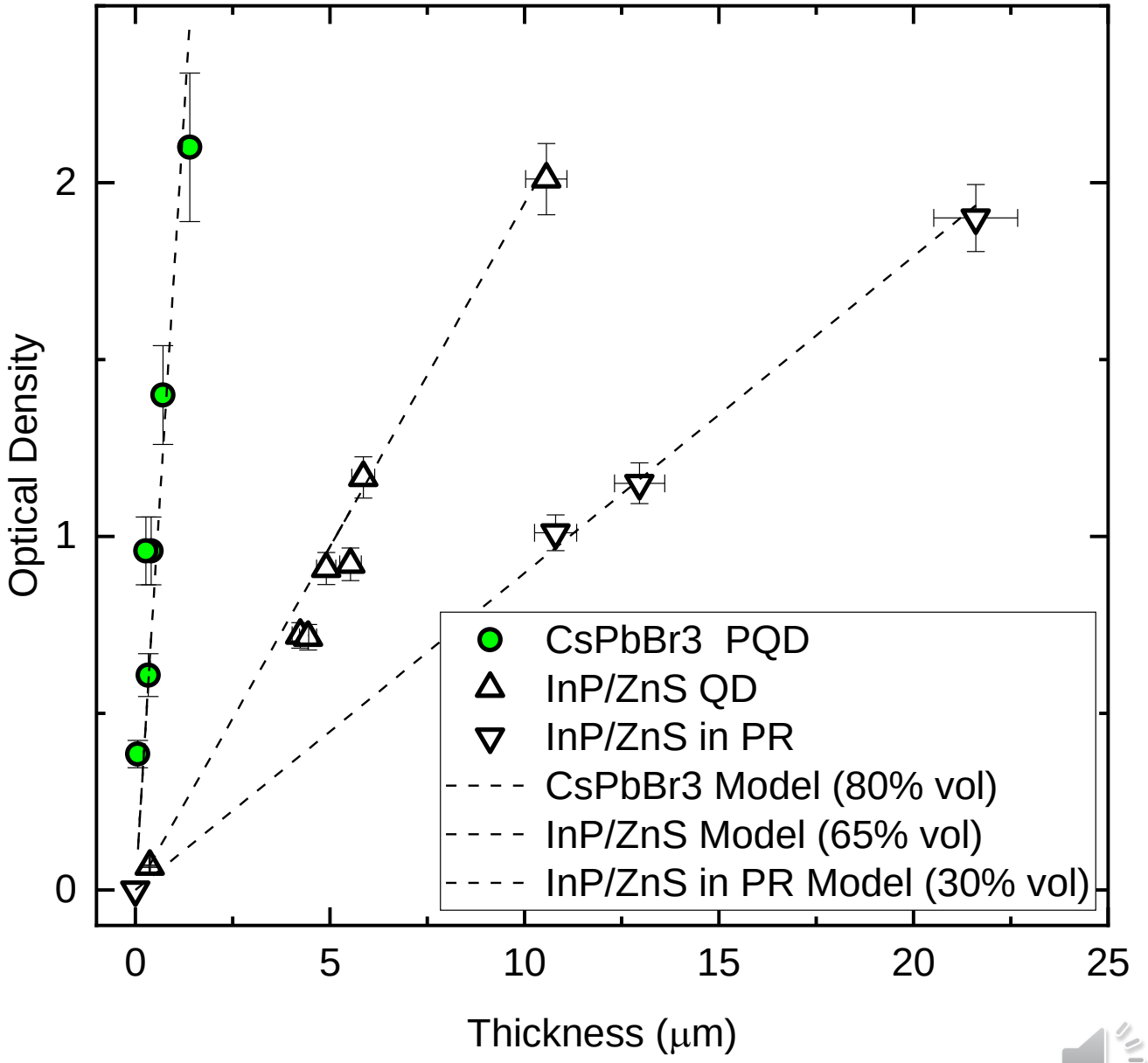

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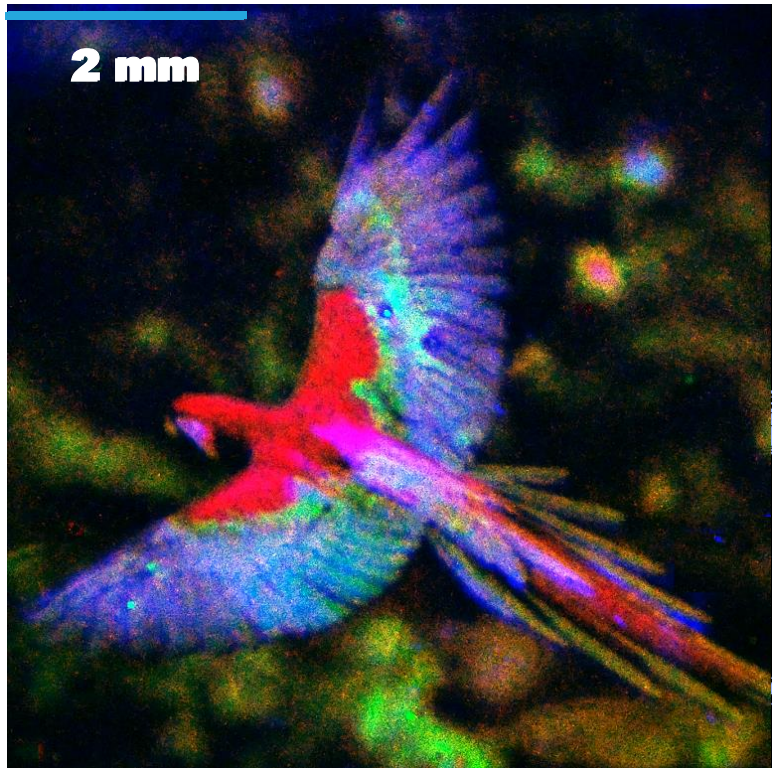
Summary



- 5 µm resolutions demonstrated at OD=2
- Perovskites can reach OD=2 by 1.2 µm
- High QY can be preserved at high packing densities with the right engineering controls

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Yu Kambe, PhD.
CEO, Co-Founder.

Dmitri Talapin, Prof.
Co-founder

Forrest Etheridge, PhD.
Senior Scientist.

Danielle Chamberlin, PhD.
Advisor

Yuanyuan Wang, Prof.
Advisor

NanoPattern TECHNOLOGIES **Team**

Jonathan Steckel, PhD.
Advisor

Ahn Pan
Student Advisor

Haoqi Wu
Student Advisor

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Gift from the office of the CTO

NSF

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SBIR Phase I Grant
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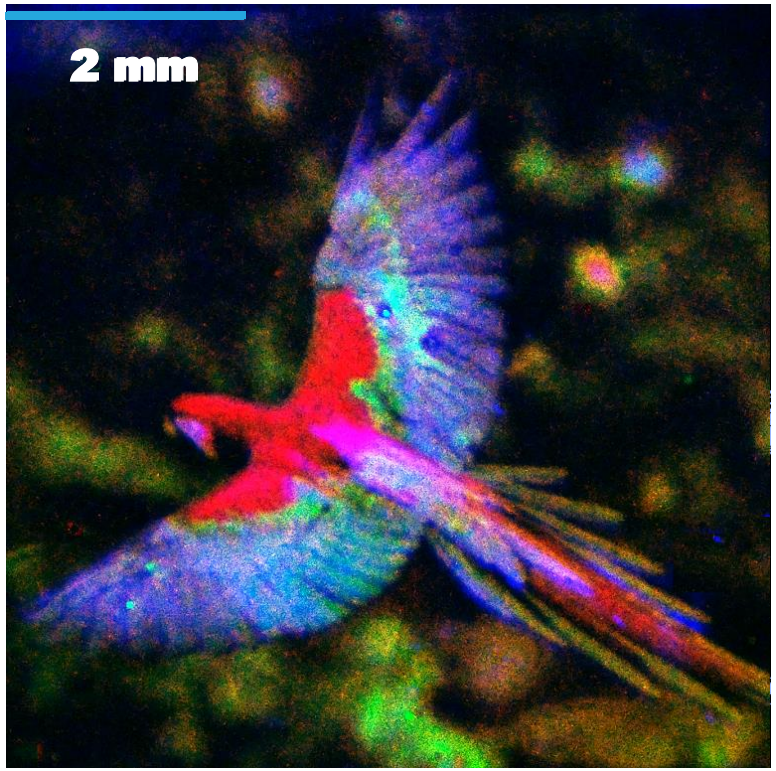

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Thank you!

yukambe@NanoPatternTechnologies.com