ADVANCED MATERIALS TECHNOLOGIES

Supporting Information

for *Adv. Mater. Technol.,* DOI: 10.1002/admt.202101525

High Quality Inkjet Printed-Emissive Nanocrystalline Perovskite $CsPbBr_3$ Layers for Color Conversion Layer and LEDs Applications

Giovanni Vescio, Juan Luis Frieiro, Andrés F. Gualdrón-Reyes, Sergi Hernández, Iván Mora-Seró, Blas Garrido, and Albert Cirera*

SUPPLEMENTARY

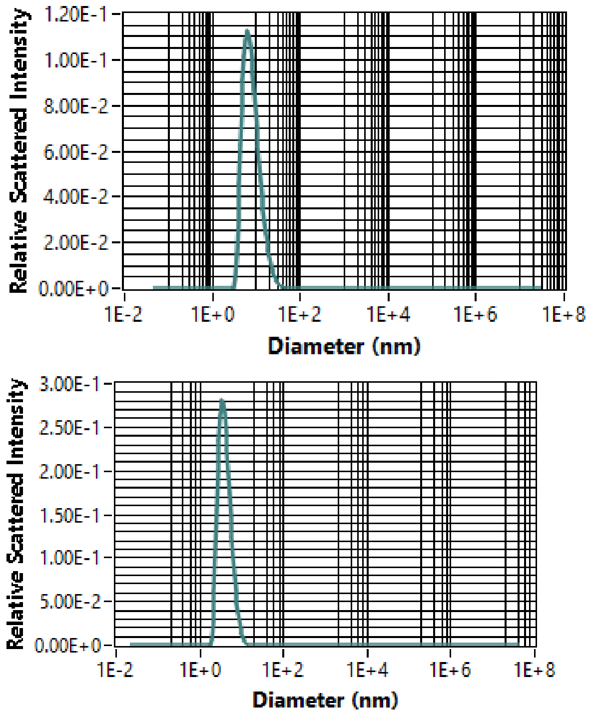


Figure S1: Ink $CsPbBr_3$ NCs are monodispersed with uniform particle size, values around 7 nm. Estimation particle size distribution using Cumulant fit and CONTIN analysis.

Other quality factors such as printing resolution (minimum pitch between two stripes), homogeneity (pinholes-free layer) and adhesion to the substrate (contact angle pinning)[43] can be fulfilled adapting parameters such as frequency of drop injection, nozzle and substrate temperature and number of drops per inch. The inkjet printing parameters used for a stable and reliable jettability are detailed in Table TS1

Parameters	Units	Value for $CsPbBr_3$ ink
Voltage Amplitude	*V*	*20*
Drop Speed	*m/s*	*6*
Nozzle Temperature	*^oC*	*24*
Drop Spacing	*µm*	*50*
Printhead – Substrate distance	*µm*	*300*
Substrate Temperature	*^oC*	*50*
Waveform frequency	*KHz*	*2*

Table TS1. Inkjet printing parameters for $CsPbBr_3$ thin films.

Table TS2 : Summary of ink rheology parameters. $CsPbBr_3$ ink parameters as derived from the rheology study: viscosity, surface tension, density, nozzle diameter, velocity, and Reynolds (Re), Weber (We), Ohnesorge (Oh) and Z numbers. As well, the Re, We and Z values under different fluid velocity are also specified.

Ink parameters		
Viscosity (η)	(g/cm·s)	0,021
Surface tension (ϒ)	dynes/cm	28
Density (ρ)	g/cm^3	1,1
Nozzle diameter (α)	cm	0,0021
Velocity (ν)	cm/s	175

Re	$(\rho \cdot v \cdot \alpha / \eta)$
We	$(\rho \cdot v^2 \cdot \alpha / \Upsilon)$
Oh	$(\frac{\sqrt{We}}{Re} = \frac{\eta}{\sqrt{\alpha\rho\Upsilon}})$
Z	$(1/Oh = \frac{\sqrt{\alpha\rho\Upsilon}}{\eta})$

Velocity	***Re***	***We***	**Z**
50	5,5	0,20625	12,1106
200	22	3,3	12,1106
500	55	20,625	12,1106
700	77	40,425	12,1106
1000	110	82,5	12,1106
1500	165	185,625	12,1106
2000	220	330	12,1106
3000	330	742,5	12,1106
4000	440	1320	12,1106

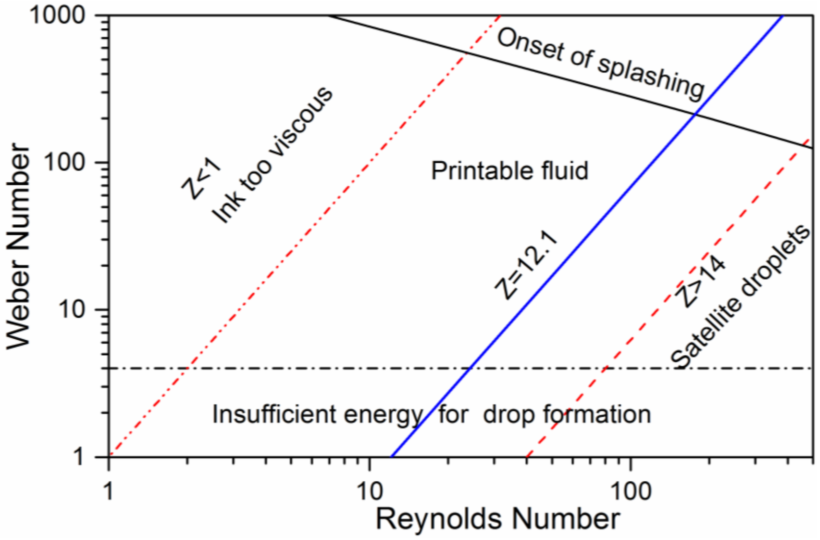


Figure S2: Ink printability according to rheology parameters. Weber-Reynolds (Log-Log) chart representing the different quality regimes for an ink to be printable. Each phase characteristics are written down in the graph.

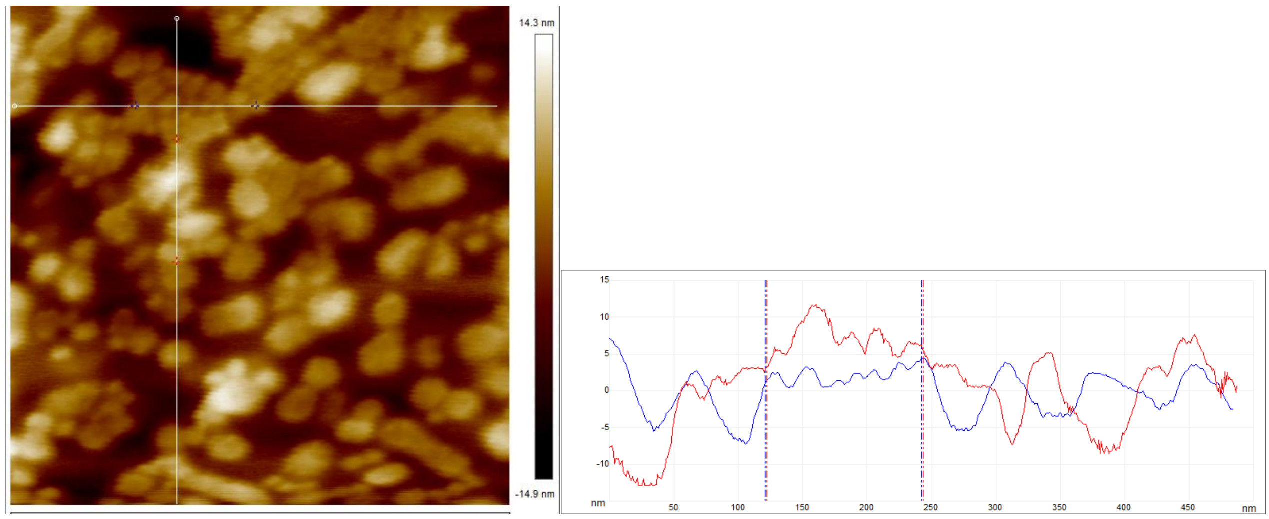


Figure 3a main manscript.

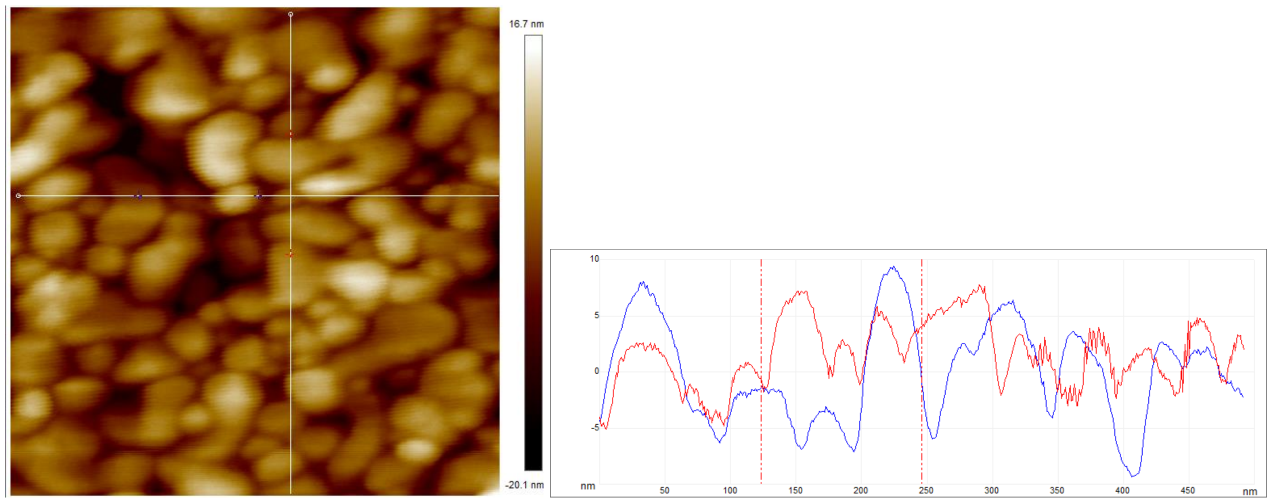
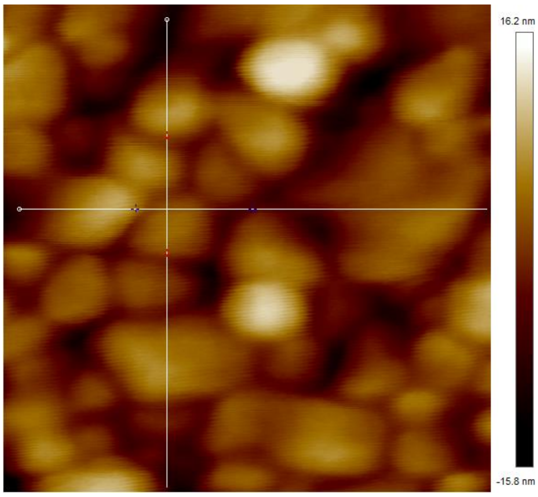


Figure 3b main manscript..



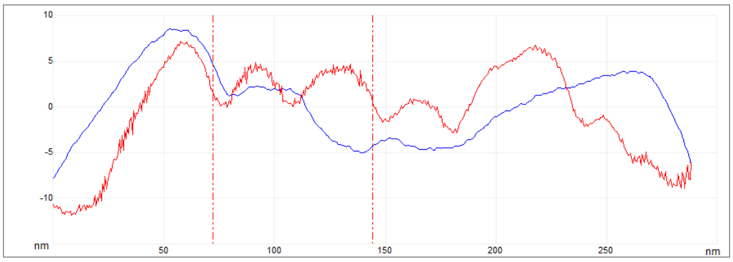
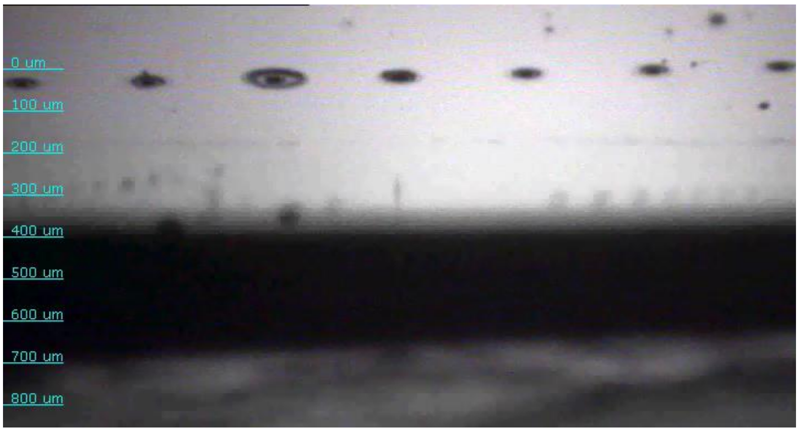


Figure 3c main manscript..

Figure S3: Cross-sectional analysis of AFM of the printed $CsPbBr_3$ Figure 3 in the manuscript.



CsPbBr3 ink jettability low.mp4

Video SV1: Ink jettabilty from the dropwatcher control of Dimitix 2851 printer. The tool allows managing the waveform to achieve a stable ejection of all the nozzles.

CsPbBr3 printed low.mp4

Video SV2: Printing patterns on selected substrate onto the Dimatix 2850 platen using a disposable printhead of 10pL drop voluume.

The molecular structural model of CsPbBr3 NCs expects that the ideal Cs : Pb : Br atomic ratio should be close to 1 : 1 : 3 for the perovskite NCs. The detailed EDX result, as shown in Fig. S2, reveals that the estimated atomic ratio of the NCs was 0.5 : 1 : 3.5 in the case of vacuum oven curing, which is presenting a Br rich surface, promising for an emission layers. On the one hand, abundant Br atoms at surface will connect with cations, inhibiting the trapping of excited electrons by surface defects, resulting in efficient usage of excited carriers and then high PLQY. On the other hand, hotplate and convection oven present an excess/surplus of Pb at the expense of Cs, with a ratio around 0.5 : 1.5 : 3.

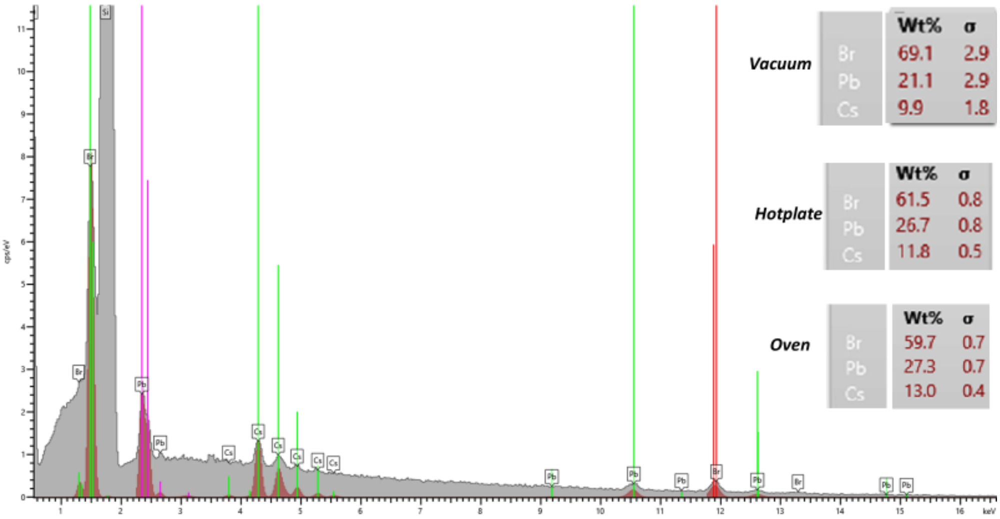


Figure S4: EDX spectrum of the colloidal CsPbBr3 NCs.

VACUUM				***HOTPLATE***				***Convection oven***			
Pb 4f	***eV***	***Area***	***Area reale %***	***Pb 4f***	***eV***	***Area***	***Area reale %***	***Pb 4f***	***eV***	***Area***	***Area reale %***
4f 7/2	138.01	3360	12.38	4f 7/2	137.83	1137	8.20	4f 7/2	137.87	1952	8.76
4f 5/2	142.88	2526	9.31		138.61	1287	9.28		138.94	2866	12.87
			21.69	4f 5/2	142.71	855	6.16	4f 5/2	142.69	1468	6.59
					143.6	768	5.54		143.71	2279	10.23
							29.18				***38.46***
Cs 3d				***Cs 3d***				***Cs 3d***			
3d 5/2	725.59	3841	10.79	3d 5/2	724.07	1049	5.77	3d 5/2	724.12	1675	5.74
3d 3/2	739.55	2561	7.20	3d 3/2	738.07	699	3.84	3d 3/2	738.07	1117	3.83
			17.99				***9.61***				***9.56***
Br 3d				***Br 3d***				***Br 3d***			
3d 5/2	69.44	1254	36.19	3d 5/2	68.35	650	36.71	3d 5/2	69.83	887	31.20
3d 3/2	70.52	836	24.13	3d 3/2	69.49	434	24.51	3d 3/2	69.9	591	20.79
			60.32				***61.21***				***51.98***

Table TS3: XPS peaks statistics. Statistics corresponding to the analysis of the different bond contributions obtained after deconvolution of the XPS spectra as shown in Fig. 7(a,b,c) in the main text.

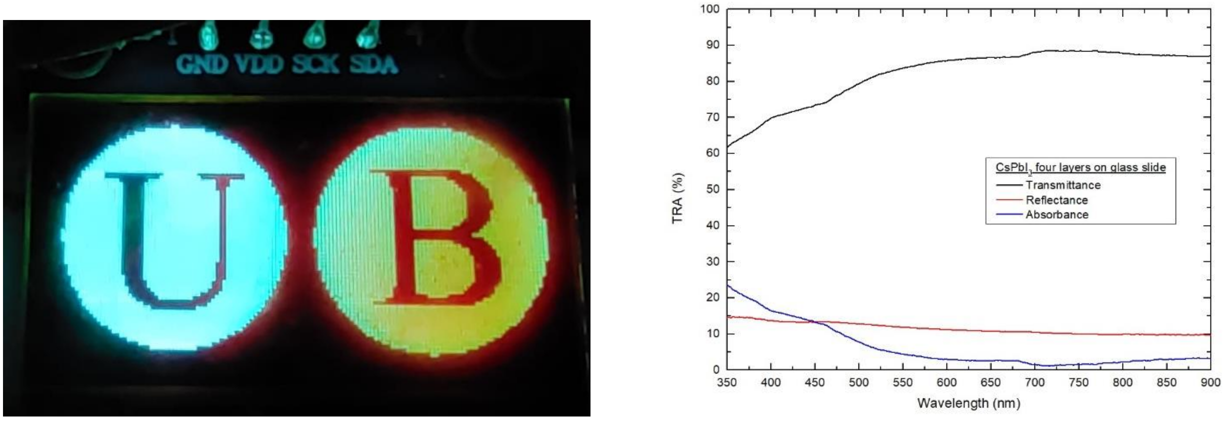


Figure S5: Optical photo of the $CsPbI_3$ perovskite CCL excited by the back blue InGaN-based micro-LED display. ATR characterization of inkjet-printed $CsPbI_3$ with expected signals for this LHP.