Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Organic-inorganic perovskite nanowire lasers through kinetically controlled growth and gas-phase halide exchange

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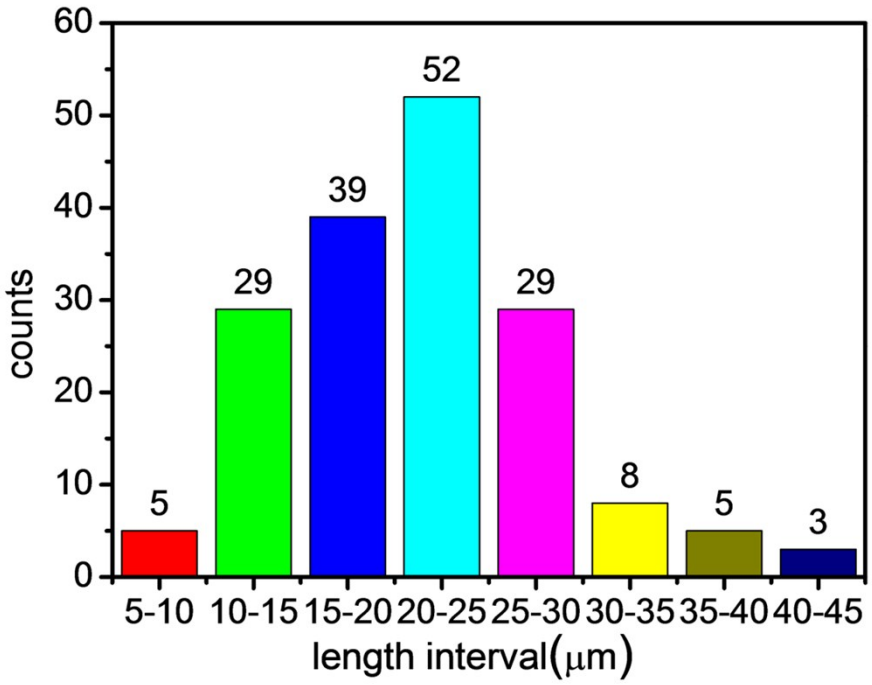


Figure S1 Length distribution of $CH_3NH_3PbCl_3$ NWs in Figure 1a showing the length of $CH_3NH_3PbCl_3$ NWs range between 5 to 45μm with 87% having lengths between 10 and 30 μ.

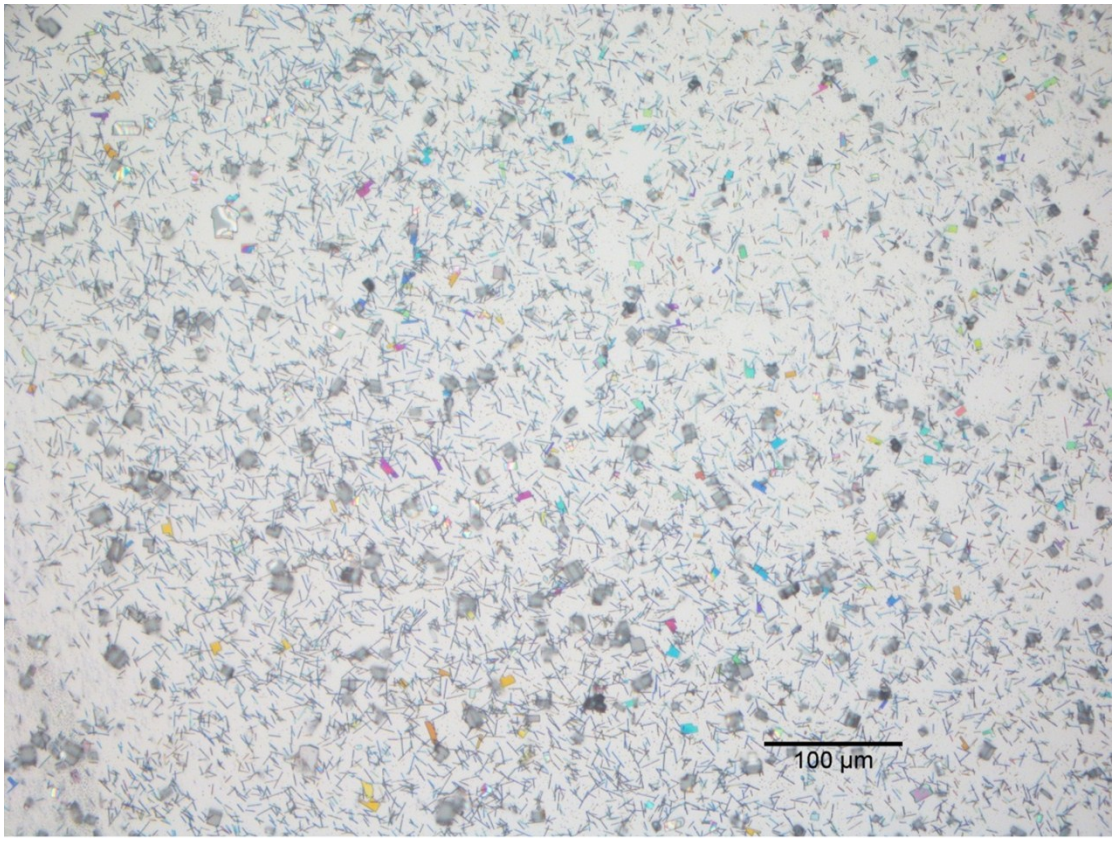


Figure S2 Lower magnification image of $CH_3NH_3PbCl_3$ NWs. It shows the uniformity of NW-microplates mixture.

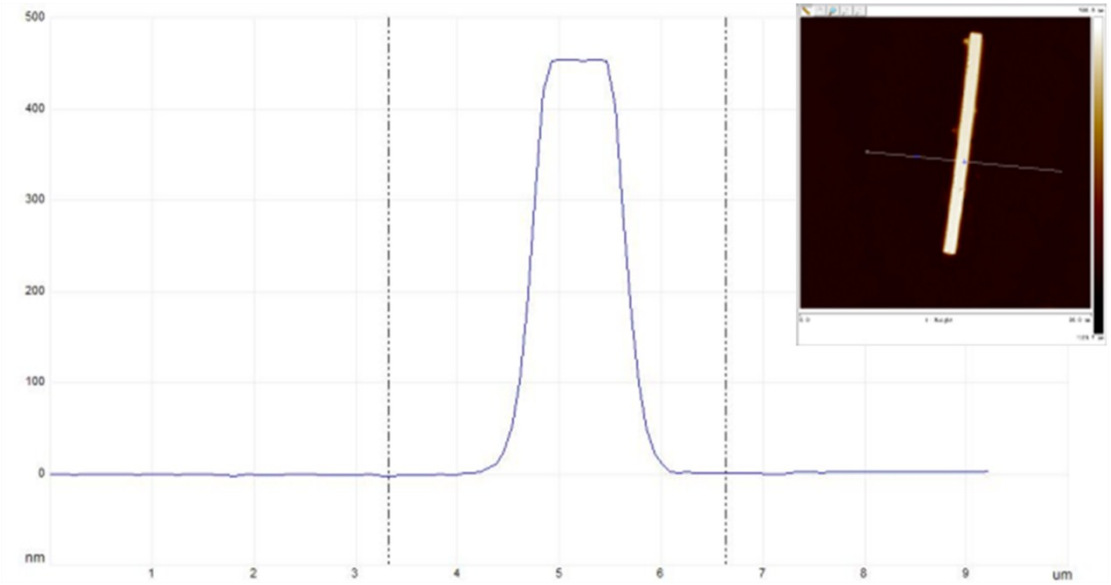


Figure S3 AFM observation of one single nanowire and the corresponding height showing the smooth surface of the nanowire with heights about 450nm.

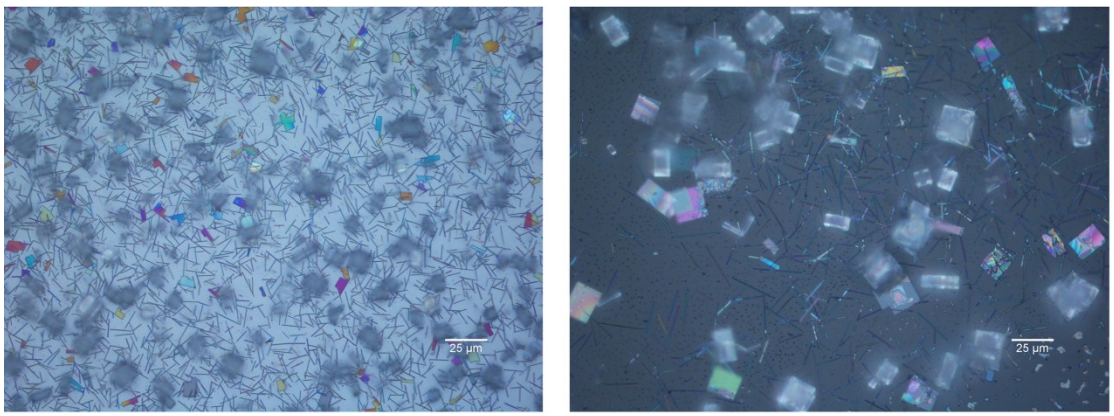
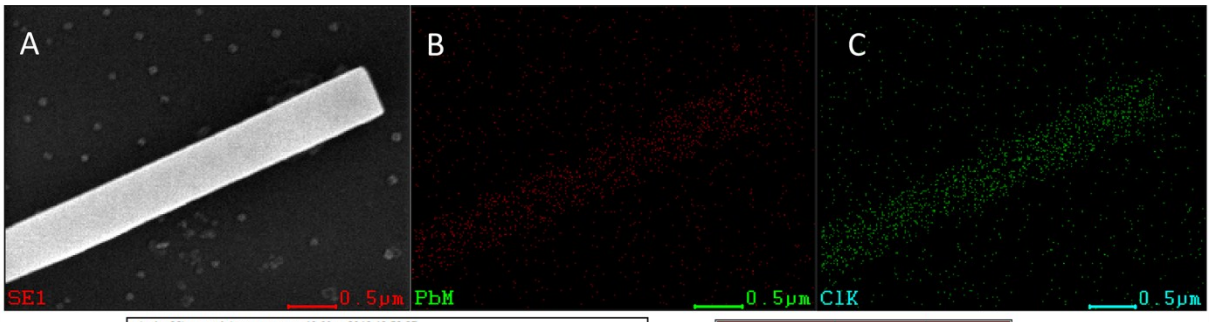
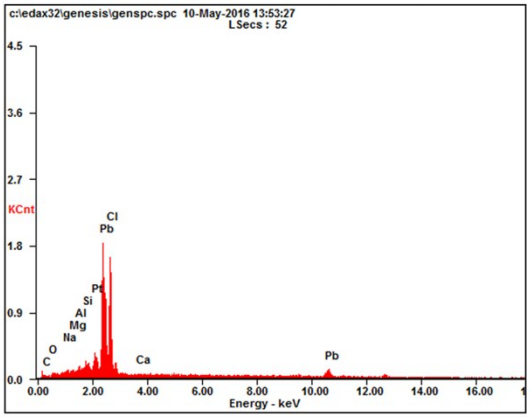


Figure S4 The optical images of $CH_3NH_3PbCl_3$ NWs on silicon(left) and glass(right) substrates. It shows the arbitrary substrates growth of those perovskite NWs.



D



E

Element	*Wt %*	*At %*
C K	02.82	14.98
O K	01.37	05.46
NaK	00.42	01.18
MgK	00.10	00.27
AlK	00.62	01.47
SiK	01.24	02.81
PtM	07.93	02.60
PbM	55.37	17.06
ClK	29.75	53.57
CaK	00.38	00.60

Figure S5 A) SEM image of a single nanowire. B,C,D,E) The corresponding Energy-dispersive X-ray Spectroscopy (EDS) analysis and element mapping of Pb and Cl in A. It presents a Cl/Pb ratio of 53.57/17.06 in good agreement with a $PbCl_3$ stoichiometry and Cl and Pb elements are uniformly distributed within nanowire of $CH_3NH_3PbCl_3$.

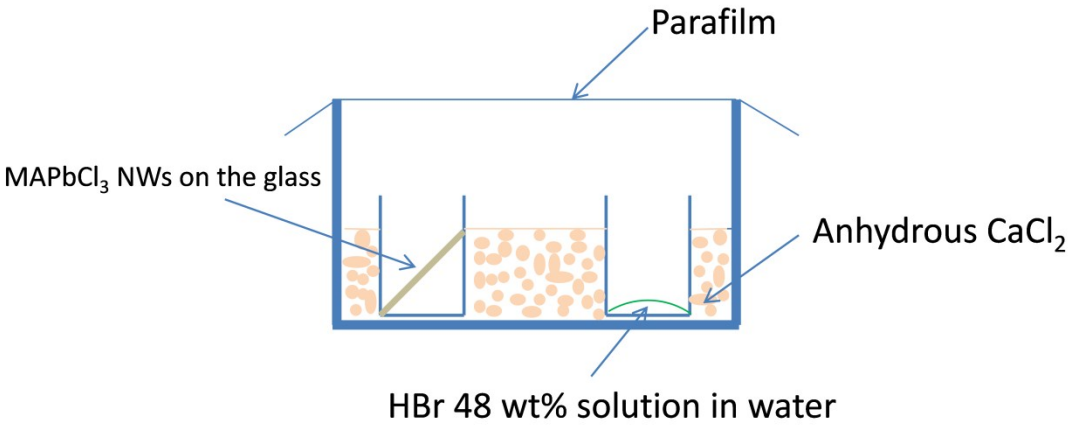


Figure S6 The diagram of experimental device applying in gas-phase halide exchange. A 70×35mm beaker contains 20×10 and 10×10mm beakers surrounded by anhydrous $CaCl_2$. The sample of $MAPbCl_3$ NWs on the glass places into the bigger beaker, 30μL high concentration HBr solution drop into the smallest, and using the Parafilm seal the biggest beaker. When anhydrous $CaCl_2$ absorb the water in high concentration HBr solution, HBr vapors react with $MAPbCl_3$ NWs on the glass. The transformation from $MAPbBr_3$ to $MAPbI_3$ use the same device as long as changing the sample and HX solution.

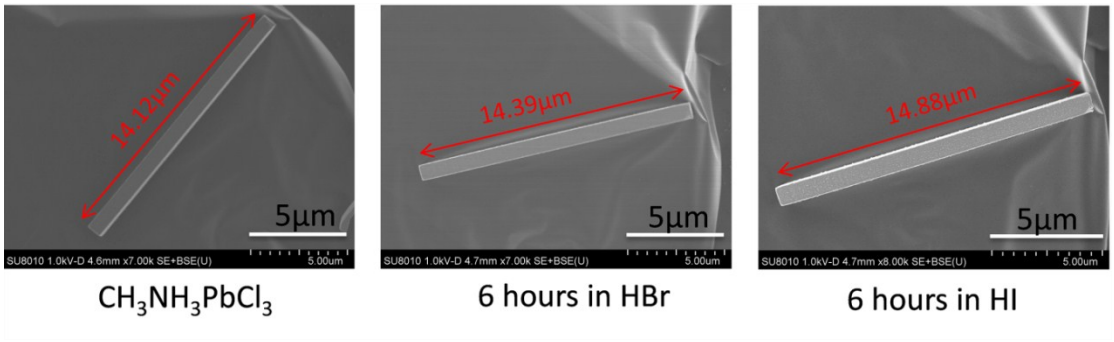


Figure S7 The original SEM images placed in Figure 2(b,c,d)

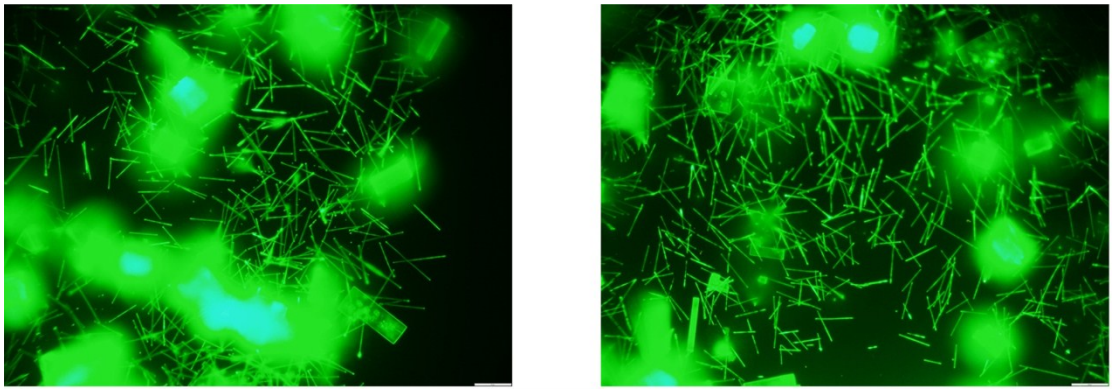


Figure S8 The fluorescence microscopy images of exchanged $MAPbBr_3$. The right had taken after placing the exchanged $MAPbBr_3$ in glovebox filling with N_2 about 24 hours at room temperature. It shows the nanowires retain the stability after they were treated by HX.

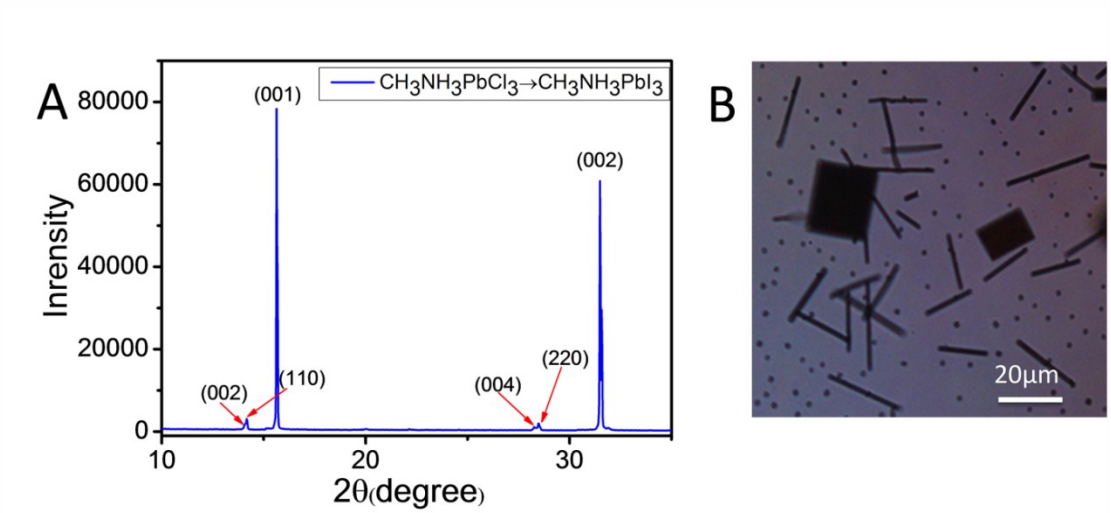


Figure S9 XRD spectrum and bright field microscopy image of the anion-exchanged samples placing $CH_3NH_3PbCl_3$ NWs in HI gas phases at 60℃ for 24h. It can be seen that the color of the NWs turn to dark totally, but only little characteristic peaks of $CH_3NH_3PbI_3$ showing in the XRD spectrum.

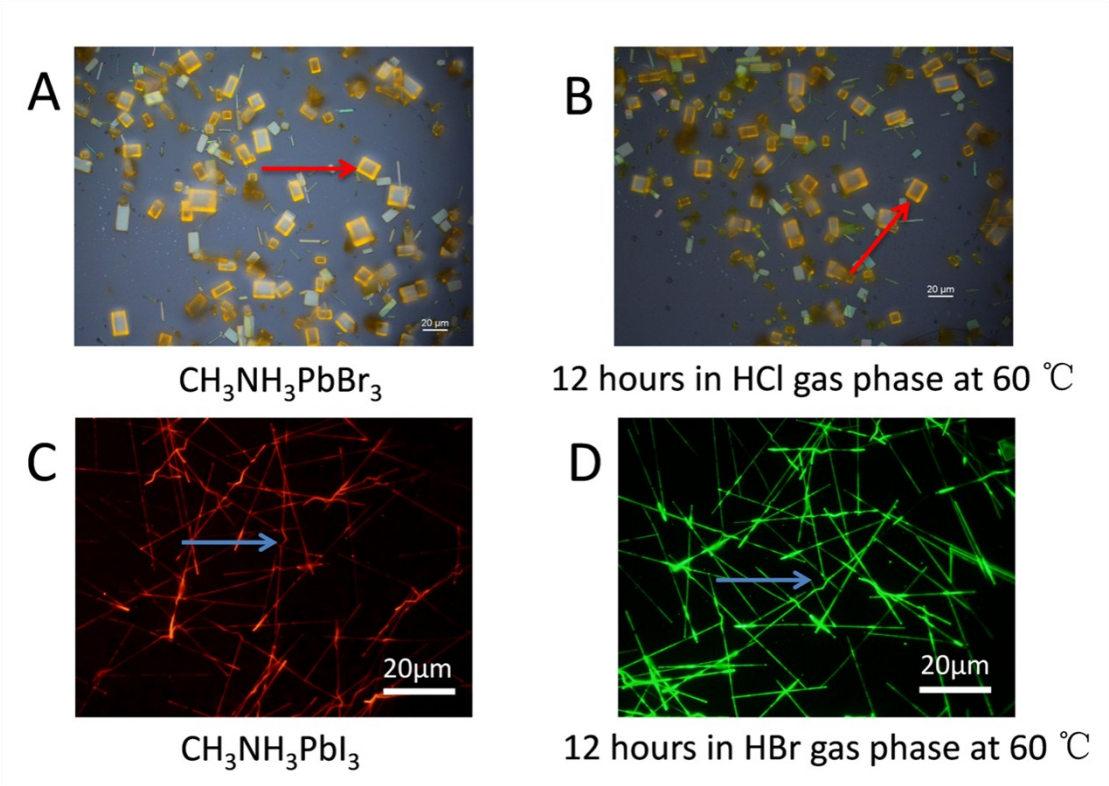
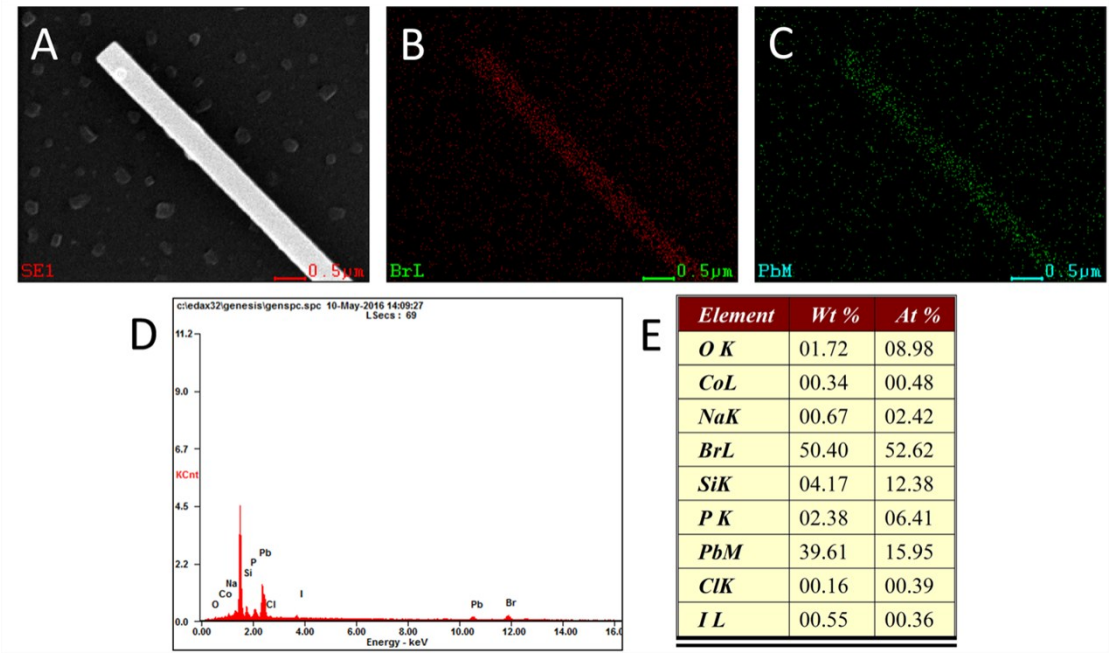


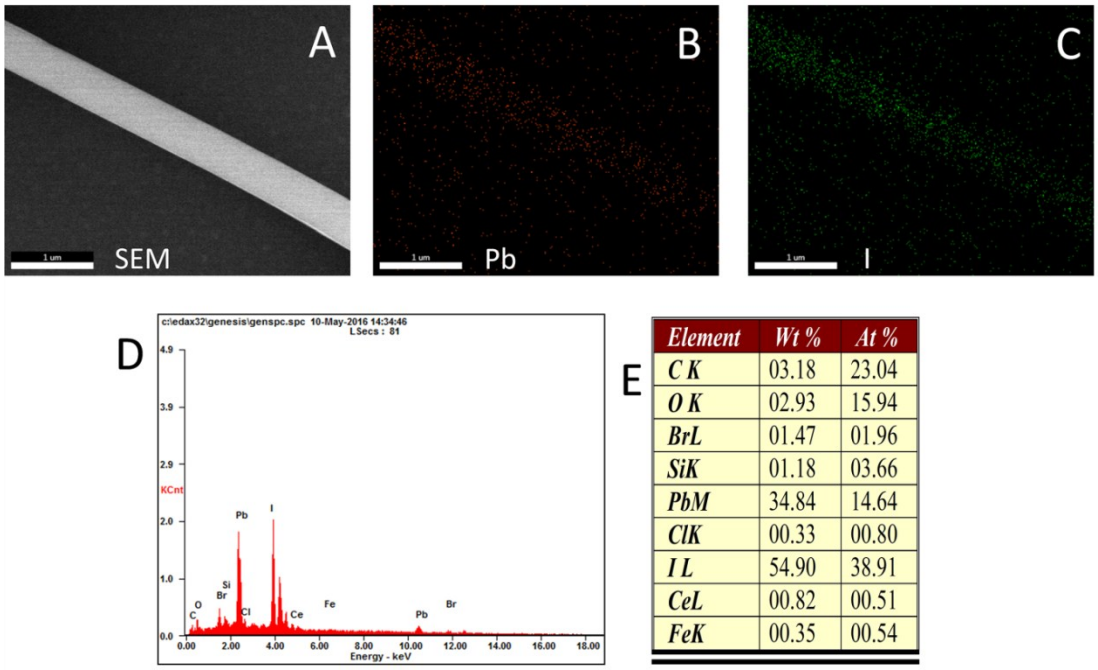
Figure S10 (A, B) Bright field microscopy images of $CH_3NH_3PbBr_3$ and corresponding crystals placed in HCl gas phase at 60 ℃ for 12 hours. (C, D) Fluorescence microscopy images of $CH_3NH_3PbI_3$ and corresponding crystals placed in HBr gas phase at 60 ℃ for 12 hours.



E

Element	Wt %	At %
O K	01.72	08.98
CoL	00.34	00.48
NaK	00.67	02.42
BrL	50.40	52.62
SiK	04.17	12.38
P K	02.38	06.41
PbM	39.61	15.95
ClK	00.16	00.39
I L	00.55	00.36

Figure S11 A) SEM image of a single nanowire. B,C,D,E) The corresponding Energy-dispersive X-ray Spectroscopy (EDS) analysis and element mapping of Pb and Br in A. It presents Br and Pb elements are uniformly distributed within nanowire of exchanged $CH_3NH_3PbBr_3$ and a Br/Pb ratio of 52.62/15.95 in good agreement with a $PbBr_3$ stoichiometry with little Cl.



E

Element	Wt %	At %
C K	03.18	23.04
O K	02.93	15.94
BrL	01.47	01.96
SiK	01.18	03.66
PbM	34.84	14.64
ClK	00.33	00.80
I L	54.90	38.91
CeL	00.82	00.51
FeK	00.35	00.54

Figure S12 A) SEM image of a single nanowire. B,C,D,E) The corresponding Energy-dispersive X-ray Spectroscopy (EDS) analysis and element mapping of Pb and I in A. It presents I and Pb elements are uniformly distributed within nanowire of exchanged $CH_3NH_3PbI_3$ and a I/Pb ratio of 38.91/14.64 in good agreement with a PbI_3 stoichiometry with little Cl and Br.

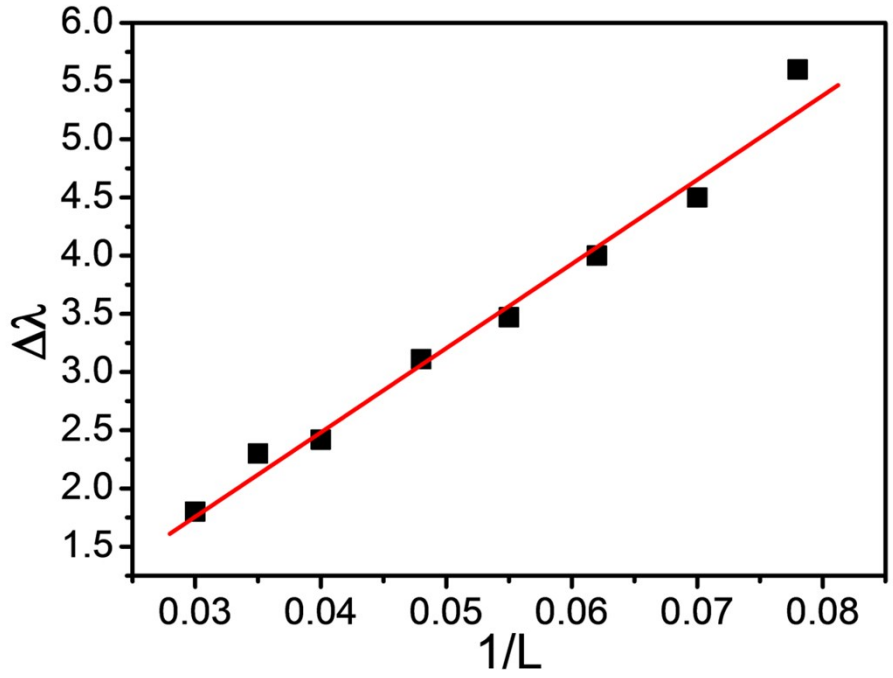


Figure S13 The mode spacing Δλ around λ=780nm versus 1/L of F-P cavity of $CH_3NH_3PbI_3$ NWs, showing clearly a linear relationship.