

**Extended Data Table 1 | TRPL curves of Ca<sup>2+</sup>-CsPbI<sub>3</sub> materials deposited on different plasmonic cavity structures, with carrier lifetime results obtained via double-exponential fitting.**

<b>Sample</b>	<b><math>\tau_1</math>(ns)</b>	<b>A<sub>1</sub>(%)</b>	<b><math>\tau_2</math>(ns)</b>	<b>A<sub>2</sub>(%)</b>	<b><math>\tau_{avg}</math>(ns)</b>
Off cavity	23.31	97.58	119.82	11.90	60.5
ONC	17.39	62.52	79.69	7.60	39.6
CNC-1	20.01	103.22	105.18	9.08	46.9
CNC-2	25.68	55.44	115.79	6.91	58.1

**Extended Data Table 2 | TRPL curves of Ca<sup>2+</sup>-CsPbI<sub>3</sub> material on the same plasmonic cavity structure under excitation light pumping at different wavelengths, with carrier lifetimes obtained via double-exponential fitting.**

<b>Pump</b>	<b><math>\tau_1</math>(ns)</b>	<b>A<sub>1</sub>(%)</b>	<b><math>\tau_2</math>(ns)</b>	<b>A<sub>2</sub>(%)</b>	<b><math>\tau_{avg}</math>(ns)</b>
395 nm	18.58	89.11	96.60	8.33	44.1
470 nm	17.39	62.52	79.69	7.60	39.6
510 nm	21.00	105.07	104.35	11.04	49.6