Electronic Supporting Information

Low-Dimensional Perovskite Nanoplatelet Synthesis Using *In Situ* Photophysical Monitoring to Establish Controlled Growth

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Experimental setup

The *in situ* photoluminescence (PL) setup (Figure S6) includes a 405 nm laser source that passes through the reaction sample, which is heated to a certain temperature in an aluminum heating block on a hot plate. Following the laser source, there is a laser line filter to reduce the spectral noise. A focus lens (F = 50.0 mm) is placed after the laser line filter. Then, a blocking edge long-pass filter (409 nm) is attached to remove scattered light from the excitation source. A second lens (F = 25.4 mm) is placed to focus the light onto the detector unit and relay the information through the optical fiber to the QE *Pro* spectrometer (*Ocean Optics*), which provides intensity and corresponding wavelength data taken every 10 milliseconds in the Oceanview computer software. With the aid of the magnetic stirring bar, it takes a few microseconds for the injected benzoyl bromide to distribute to that particular level of the solution that is excited by the laser source.

Supporting results

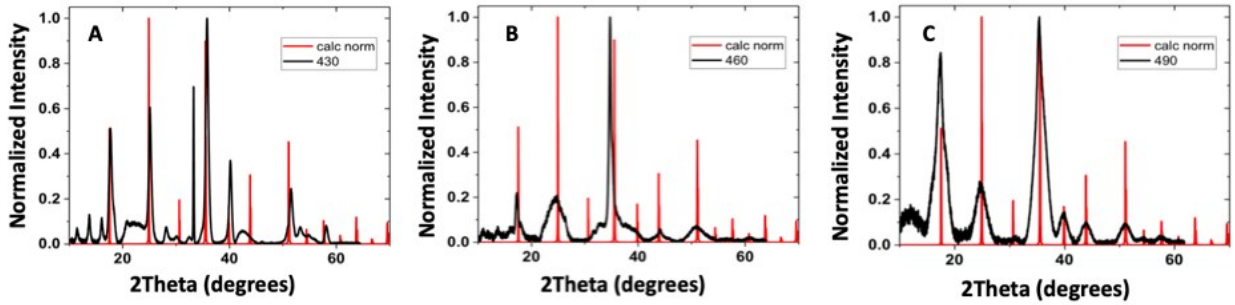

Figure S1. XRD patterns of (a) 2 unit cell, (b) 4 unit cell and (c) 6 unit cell thick $CsPbBr_3$ NPLs emitting at 430 nm, 460 nm and 490 nm, respectively. PXRD data were acquired using a Bruker AXS D8 Discover GADDS X-Ray Diffractometer equipped with a Vantec-500 area detector and is operated at 35 kV and 40 mA at a wavelength of Co Kα (1.79 Å). Ideal diffraction patterns were simulated with vesta software package using the first two spectral lines.

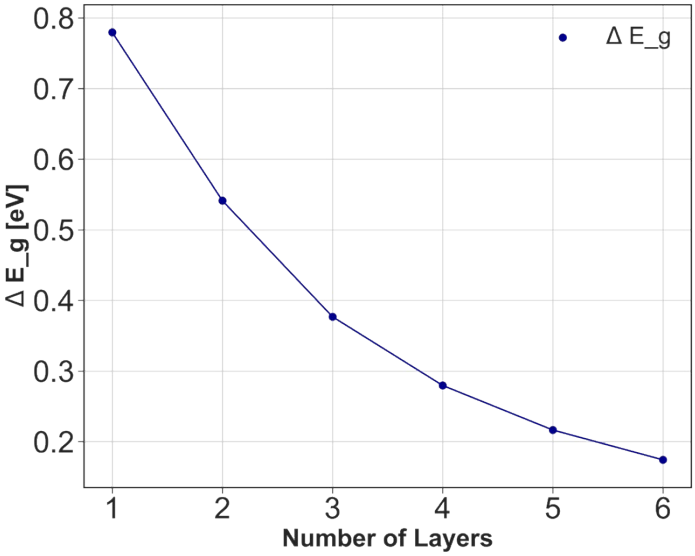

Figure S2. Calculated ΔE_g for 1-6 layer nanoplates. The observed band gap of bulk $CsPbBr_3$ is about 2.3 eV.[1] Thus, the actual band gap of the plates can be best estimated as 2.3 eV + ΔE_g.

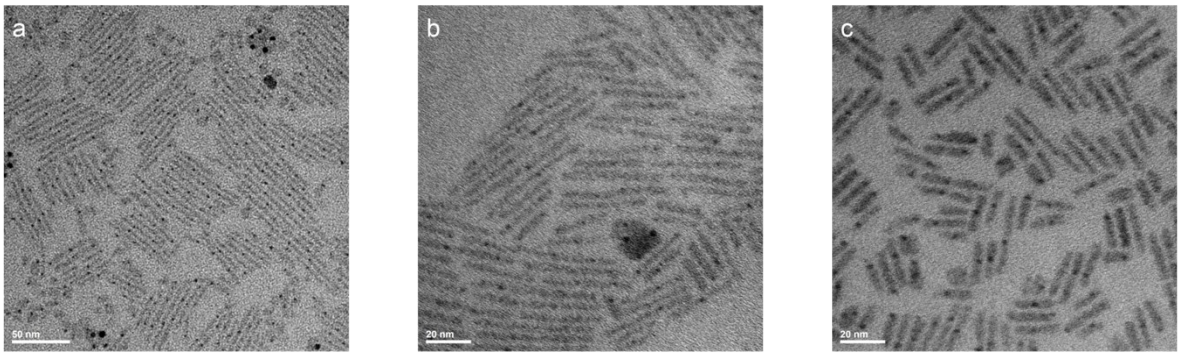

Figure S3. TEM images of (a) 4 unit cell, (b) 5 unit cell and (c) 6 unit cell thick $CsPbBr_3$ NPLs.

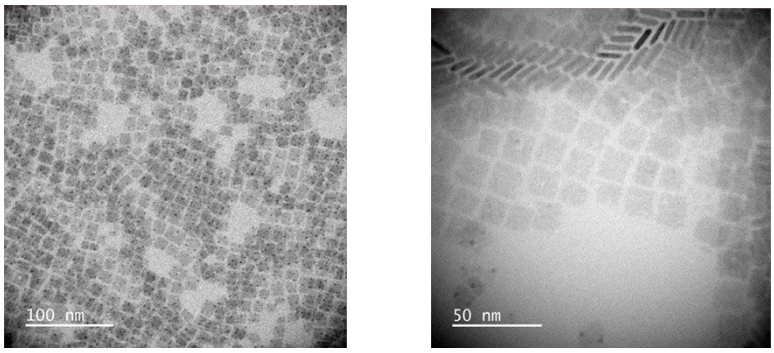

Figure S4. TEM images of 6 unit cell thick $CsPbBr_3$ NPLs.

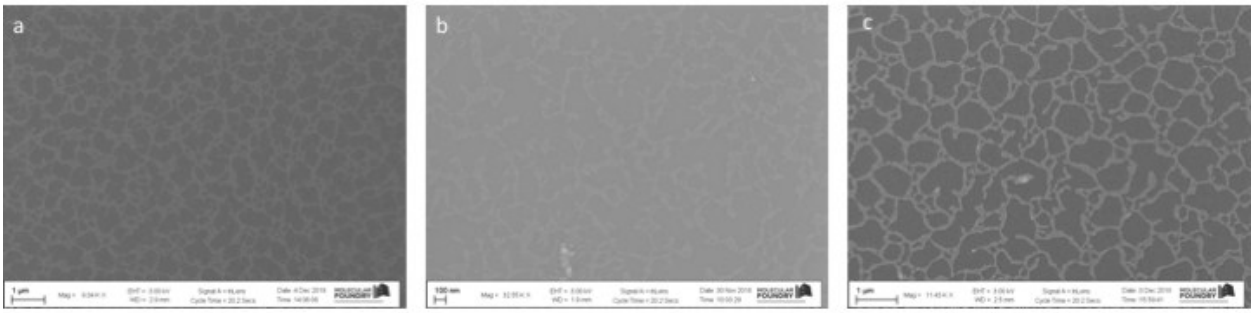

Figure S5. SEM images of (a) 2 unit cell, (b) 4 unit cell and (c) 6 unit cell thick $CsPbBr_3$ NPLs.

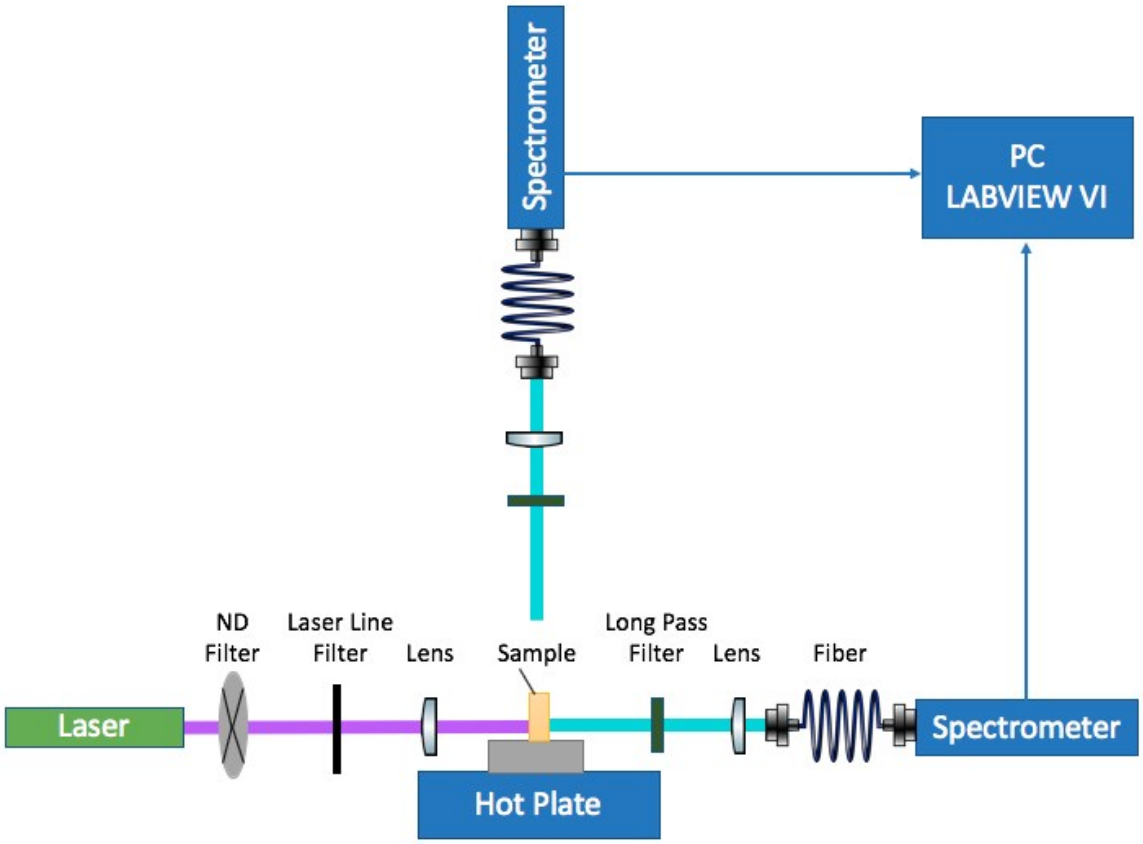

Figure S6. Schematic of the horizontal and vertical *in situ* photoluminesence setup.

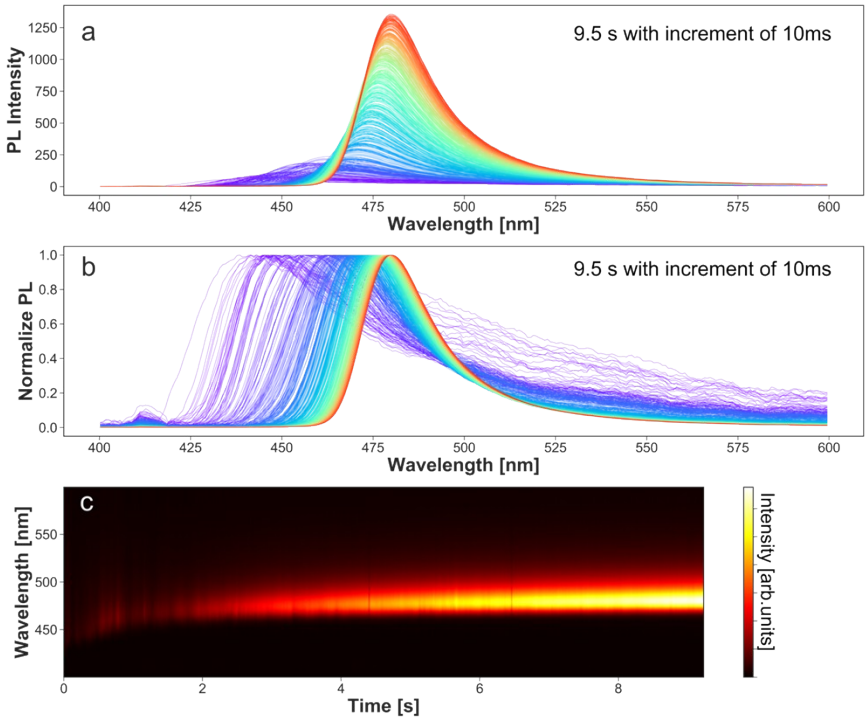

Figure S7. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 60 °C for an OA:OLAm ratio of 1:3.

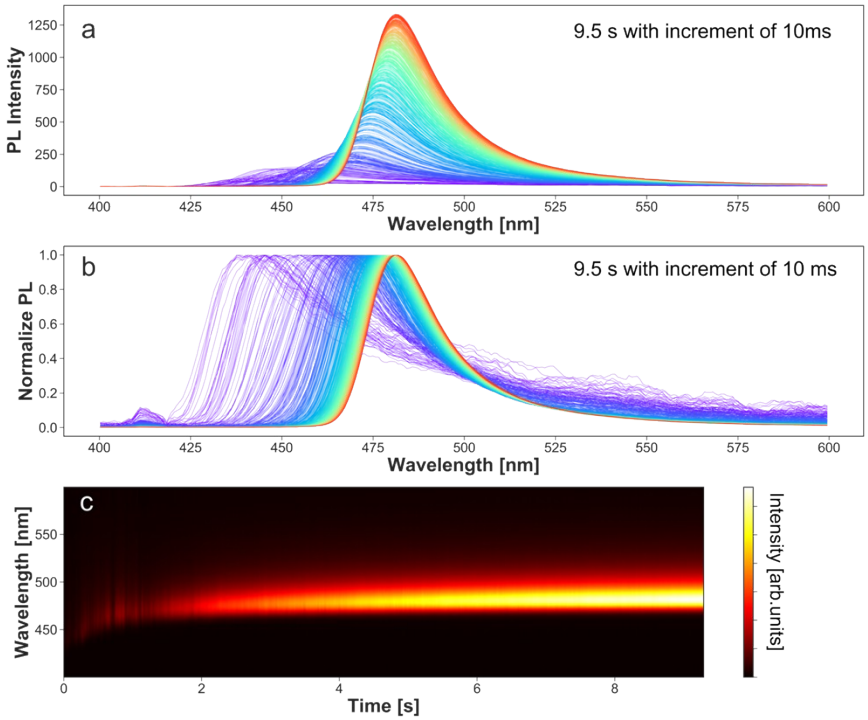

Figure S8. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 70 °C for an OA:OLAm ratio of 1:3.

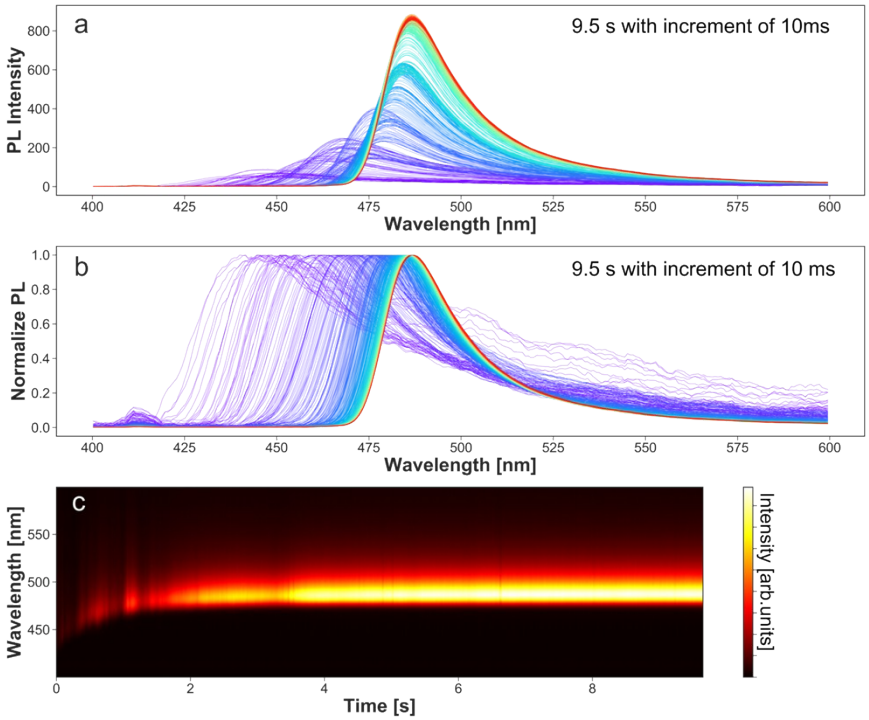

Figure S9. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 80 °C for an OA:OLAm ratio of 1:3.

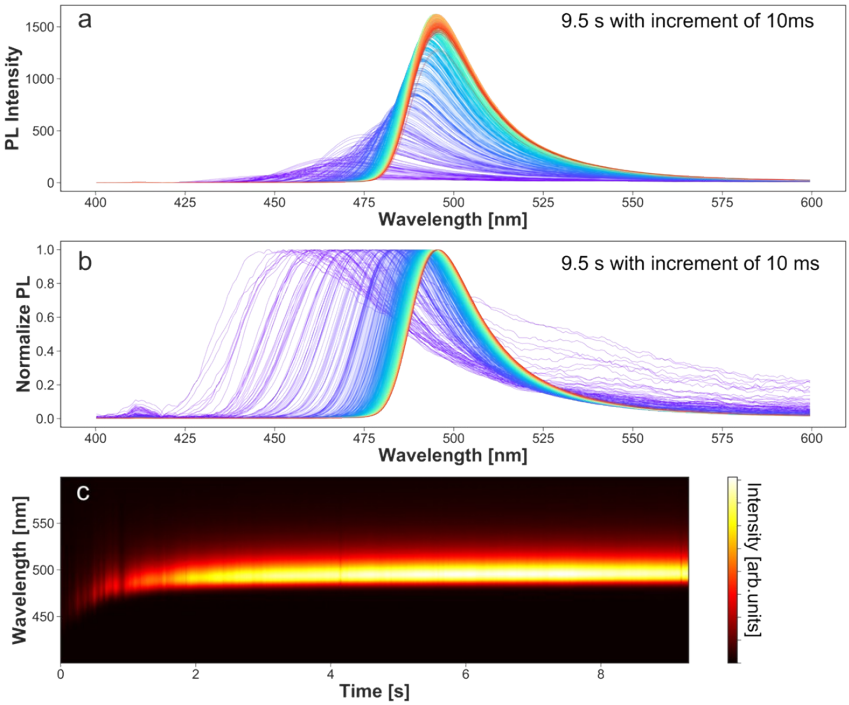

Figure S10. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 90 °C for an OA:OLAm ratio of 1:3.

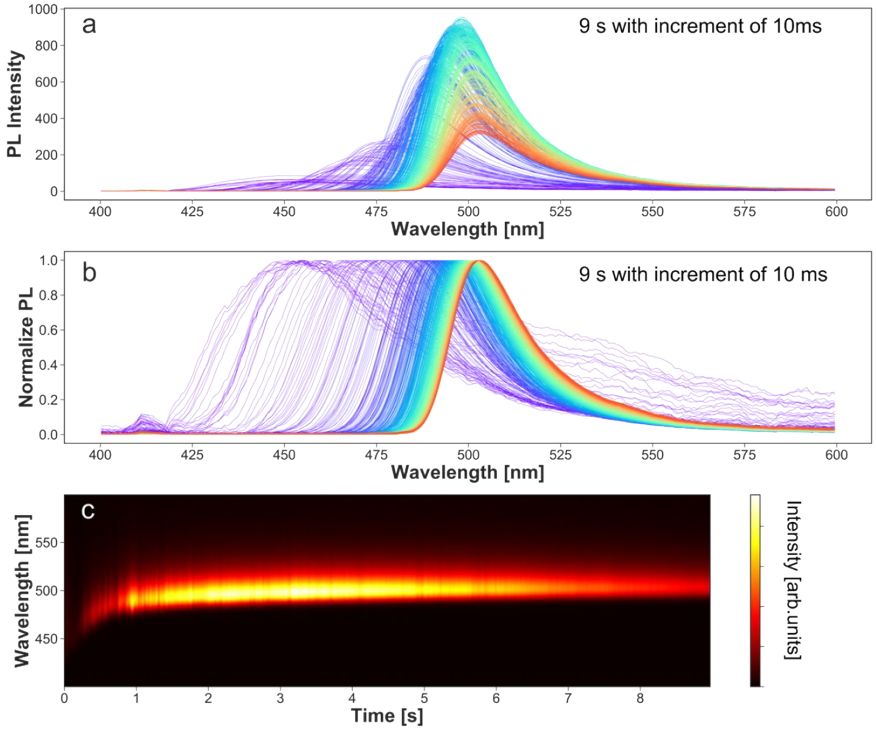

Figure S11. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 100 °C for an OA:OLAm ratio of 1:3.

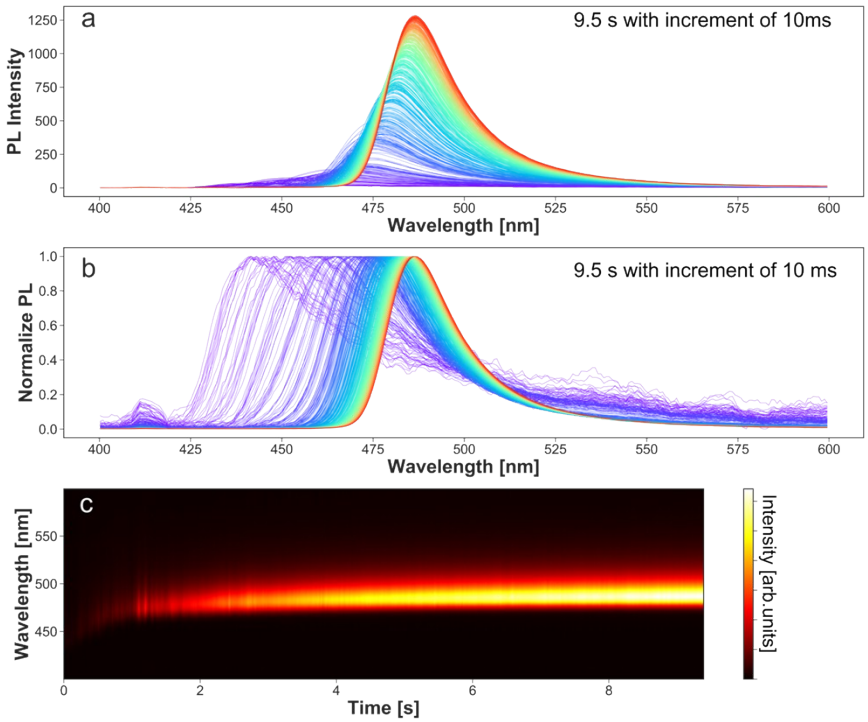

Figure S12. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 60 °C for an OA:OLAm ratio of 1:2.

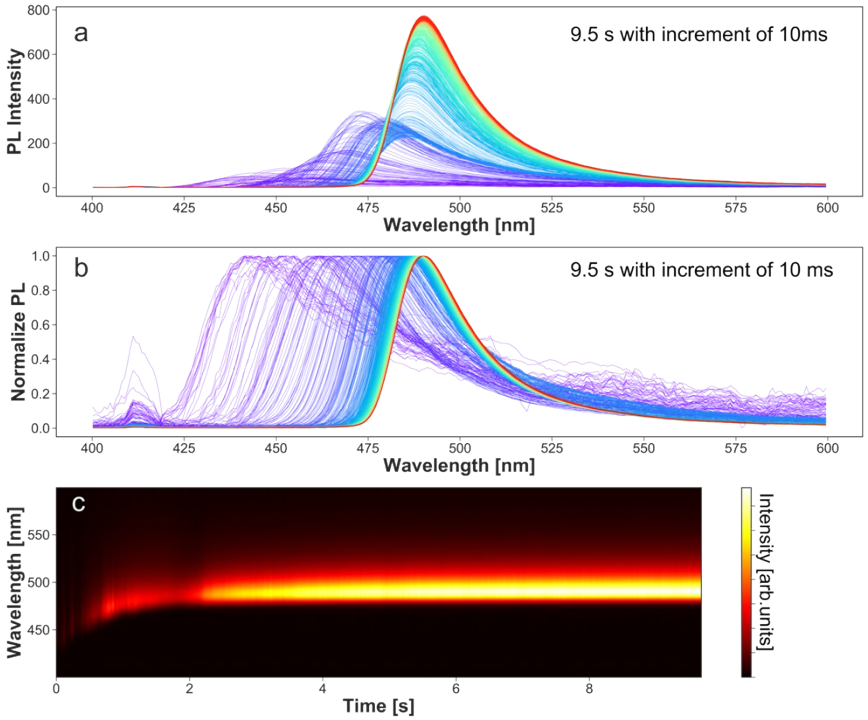

Figure S13. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 70 °C for an OA:OLAm ratio of 1:2.

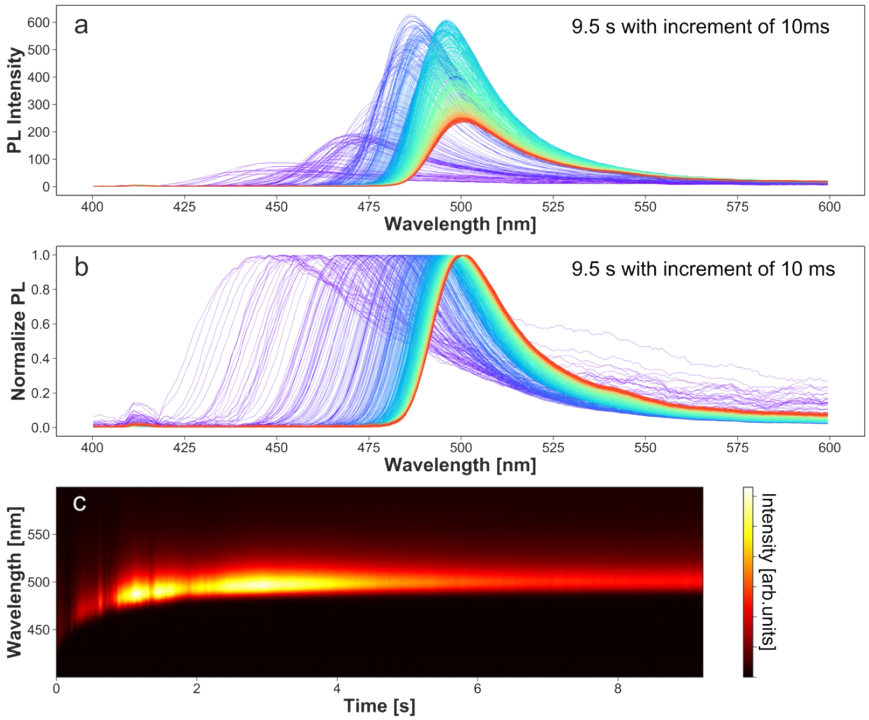

Figure S14. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 80 °C for an OA:OLAm ratio of 1:2.

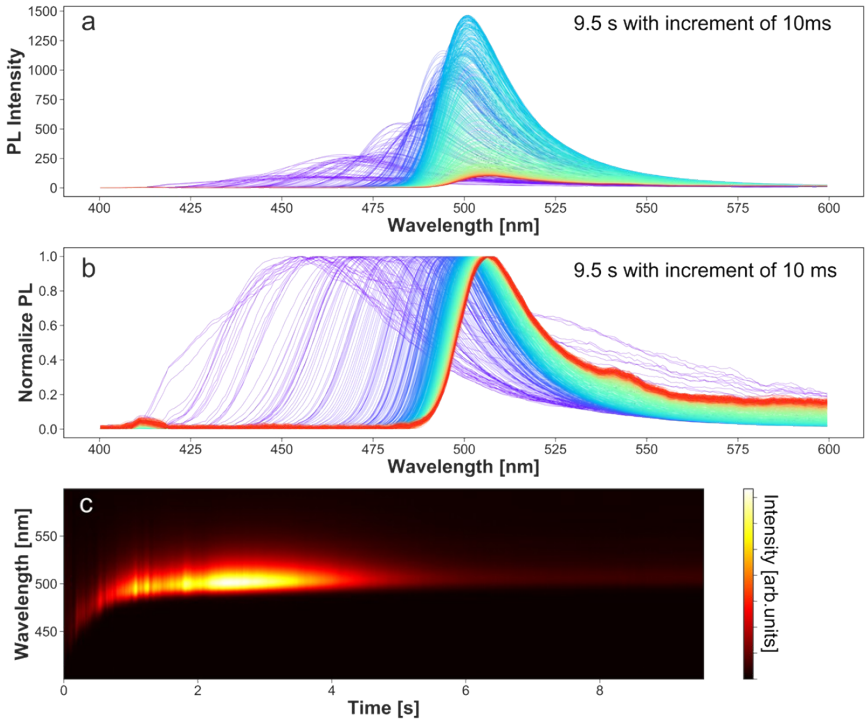

Figure S15. emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 90 °C for an OA:OLAm ratio of 1:2.

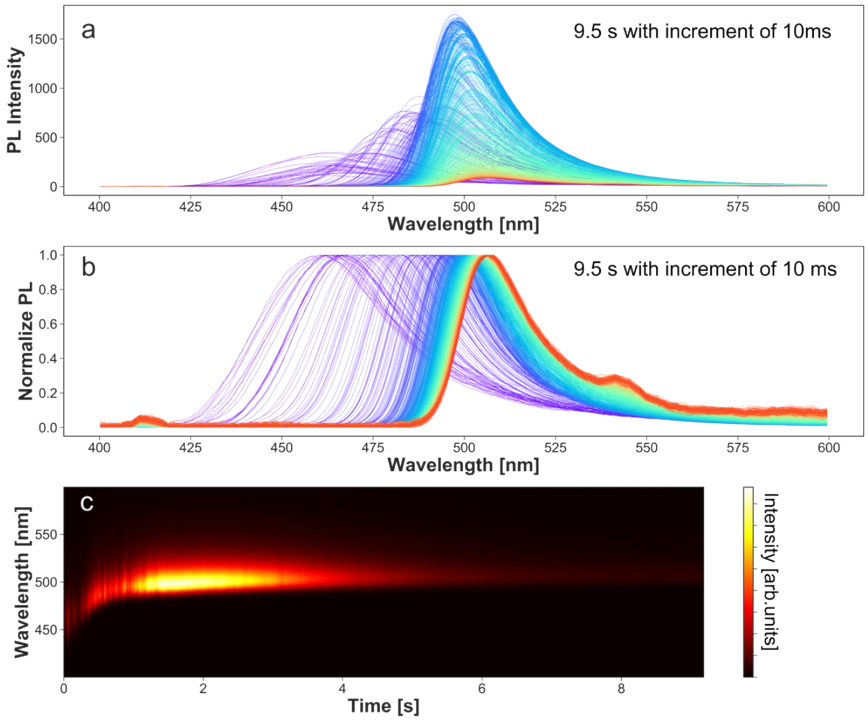

Figure S16. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 100 °C for an OA:OLAm ratio of 1:2.

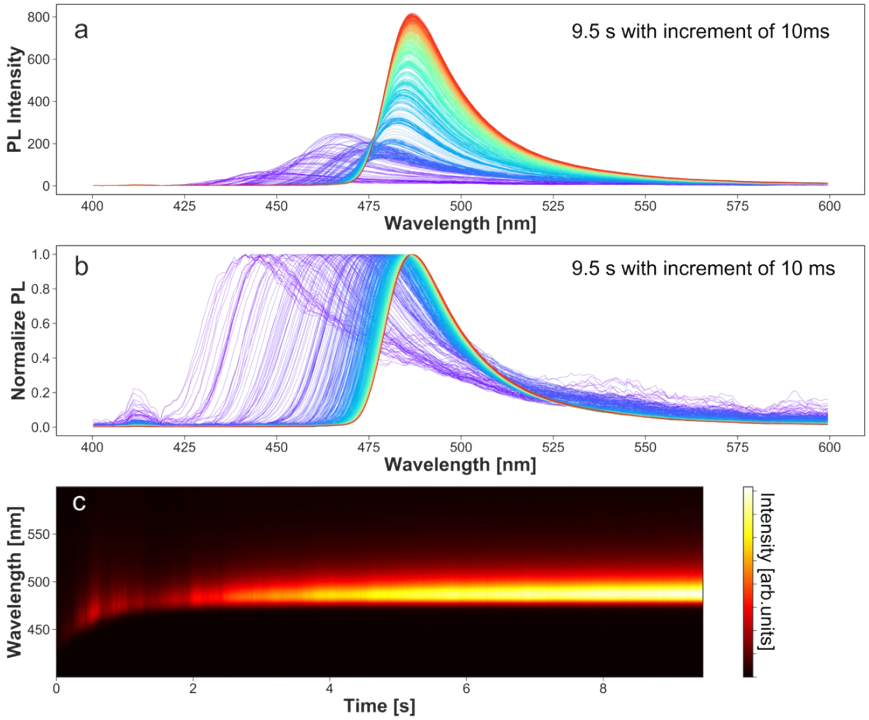

Figure S17. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 60 °C for an OA:OLAm ratio of 1:1.

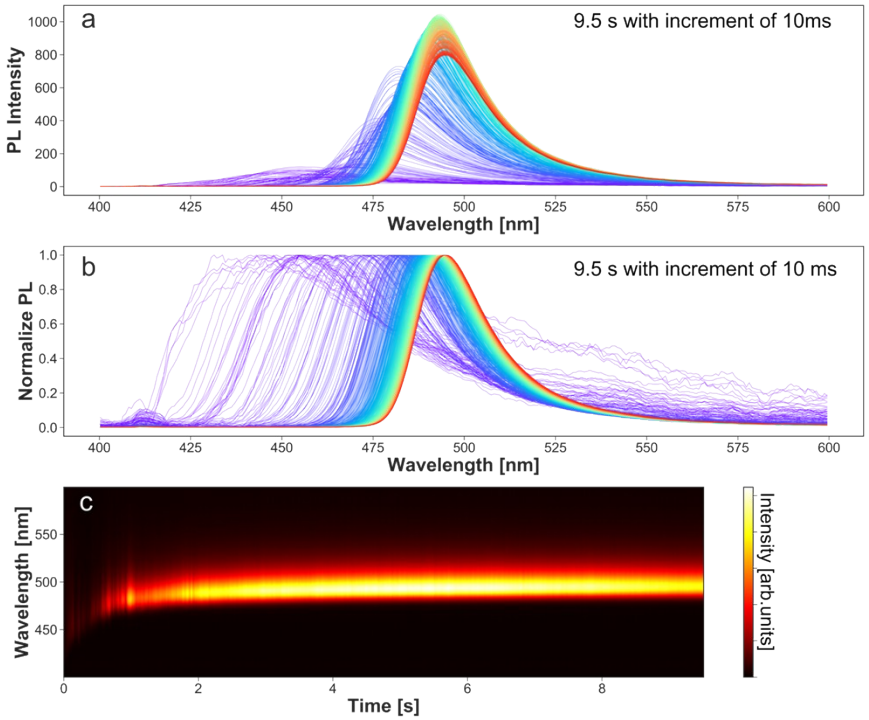

Figure S18. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 70 °C for an OA:OLAm ratio of 1:1.

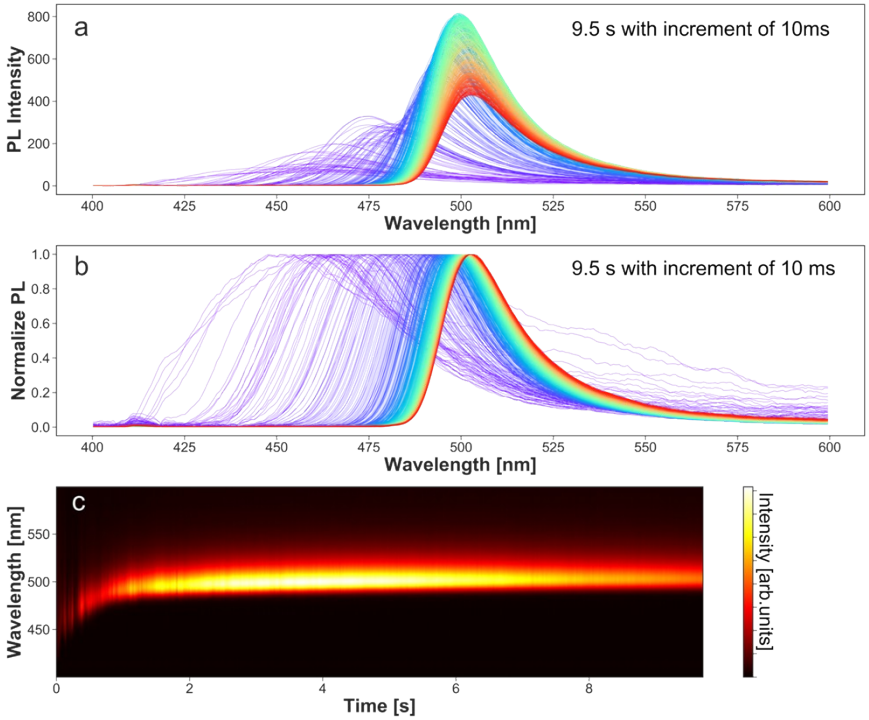

Figure S19. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 80 °C for an OA:OLAm ratio of 1:1.

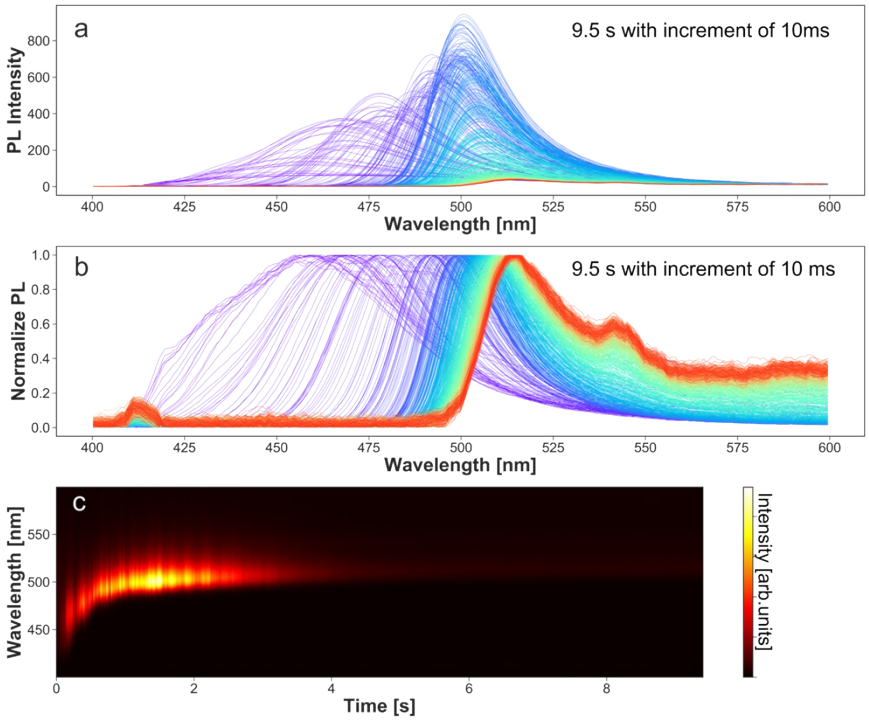

Figure S20. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 90 °C for an OA:OLAm ratio of 1:1.

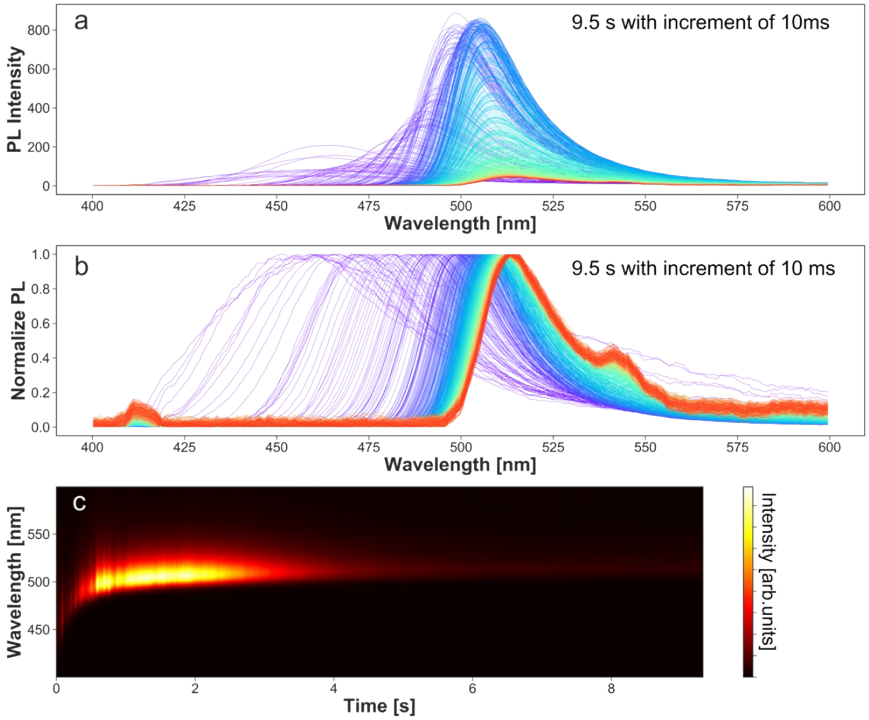

Figure S21. PL emission intensity (a), normalized PL spectra (b) and heat map (c) of a reaction at 100 °C for an OA:OLAm ratio of 1:1.

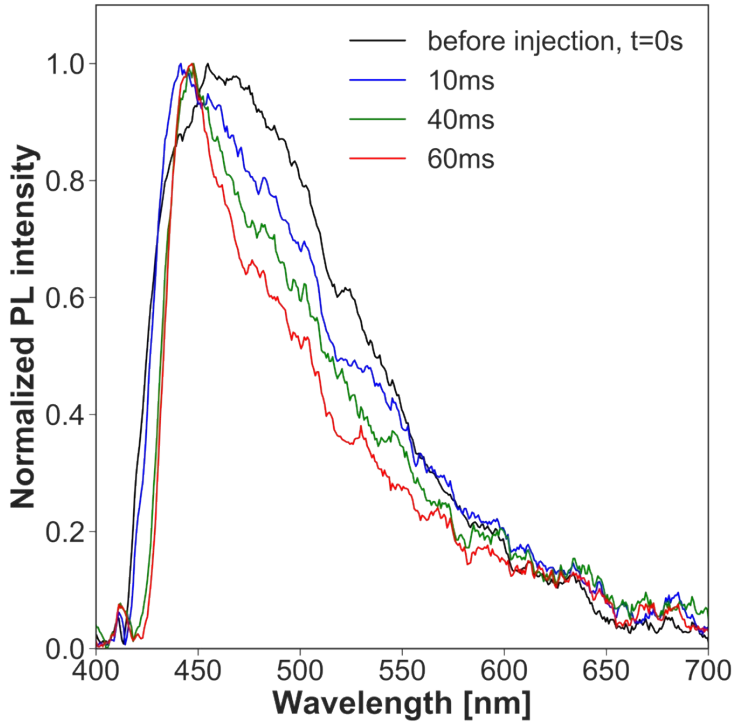

Figure S22. Normalized PL spectra before injection of benzoyl bromide and evolution of PL spectra after injection of benzoyl bromide. Sample from OA:OLAm of 1:3 at 80°C

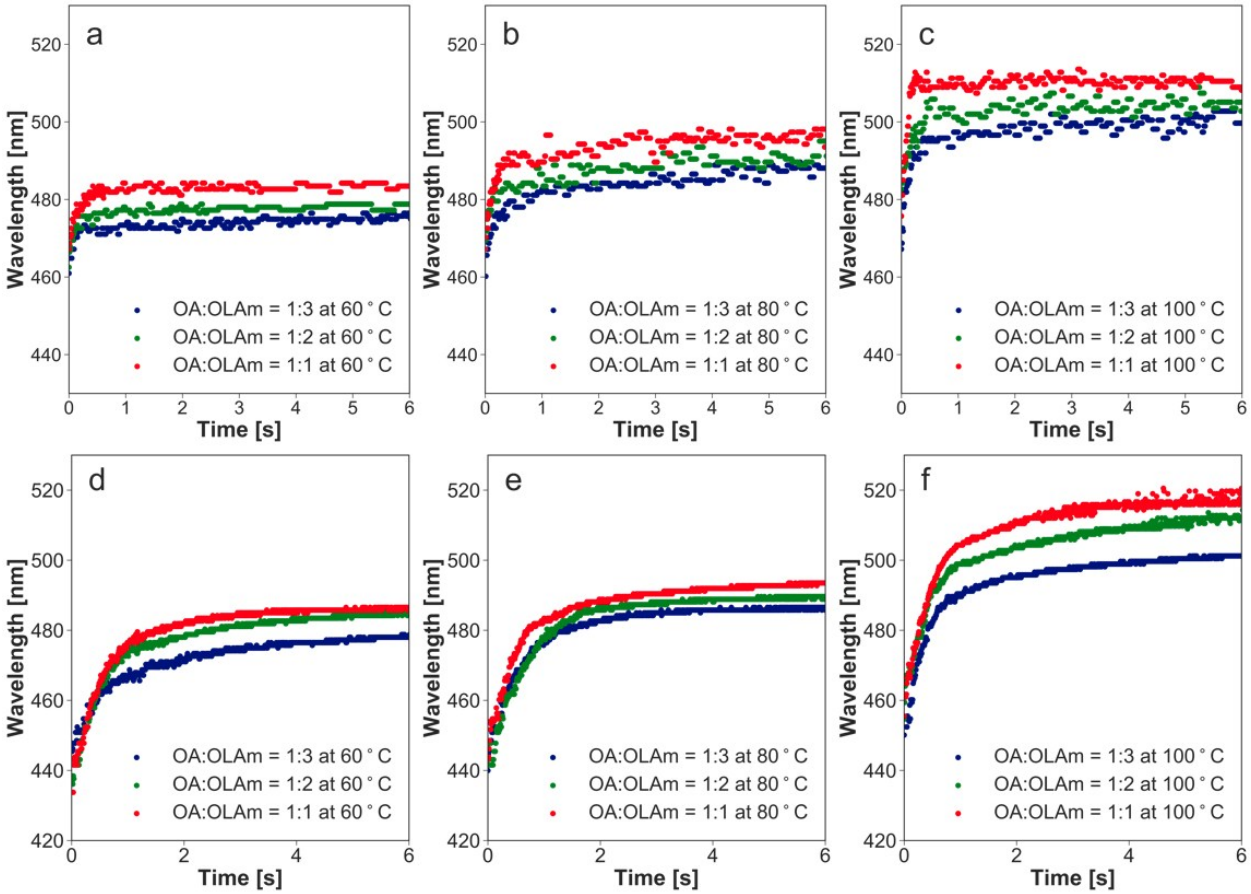

Figure S23: PL emission wavelength of the vertical set up (a,b,c) and horizontal set up (d, e, f).

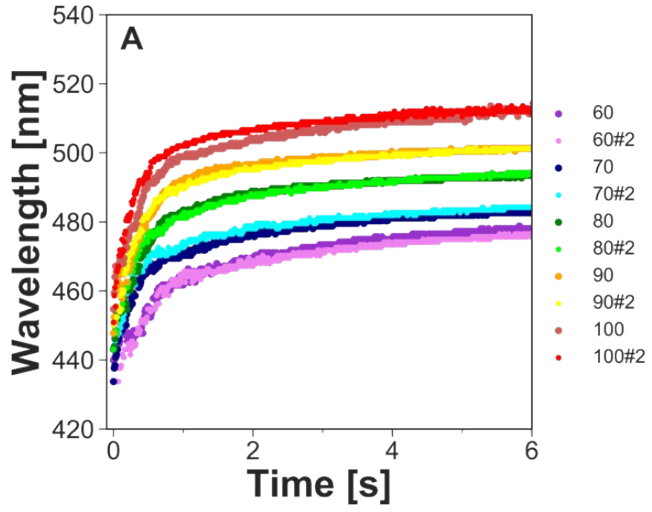

Figure S24: PL emission wavelength versus time reproduced for multiple individual reactions under the same synthetic conditions.

Reference:

1. Liang, J.; Wang, C.; Wang, Y.; Xu, Z.; Lu, Z.; Ma, Y.; Zhu, H.; Hu, Y.; Xiao, C.; Yi, X.; Zhu, G.; Lv, H.; Ma, L.; Chen, T.; Tie, Z.; Jin, Z.; Liu, J., All-Inorganic Perovskite Solar Cells. *J. Am. Chem. Soc.* **2016,** *138* (49), 15829-15832.