Electronic Supplementary Information

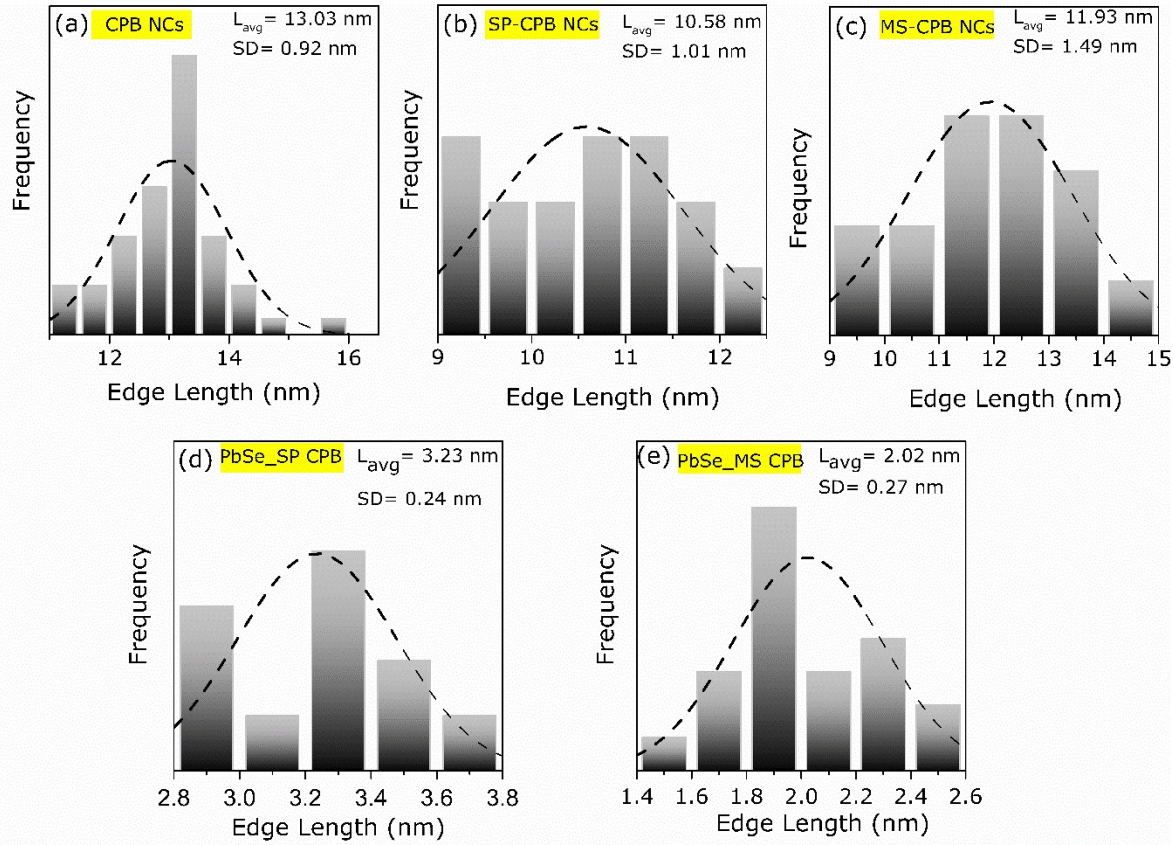

Figure S1. Histograms corresponding to **(a)** pristine CPB NCs, **(b)** SP-CPB NCs, and **(c)** MS-CPB NCs, showing size distribution of CPB in all cases; **(d), (e)** histograms showing size distribution of PbSe particles in SP-CPB and MS-CPB NCs, respectively.

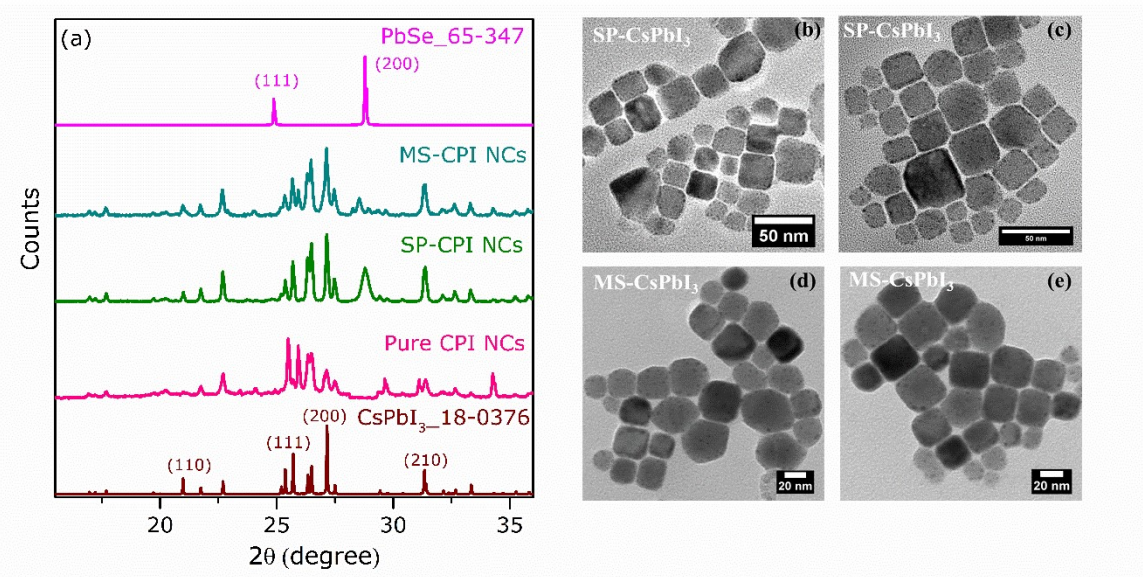

Figure S2. (a) PXRD pattern of CPI NCs and MS/SP-CPI along with their reference pattern; TEM images of **(b), (c)** SP-CPI NCs; **(d), (e)** MS-CPI NCs, illustrating cubic morphology of CPI NCs, decorated with dot like PbSe particles.

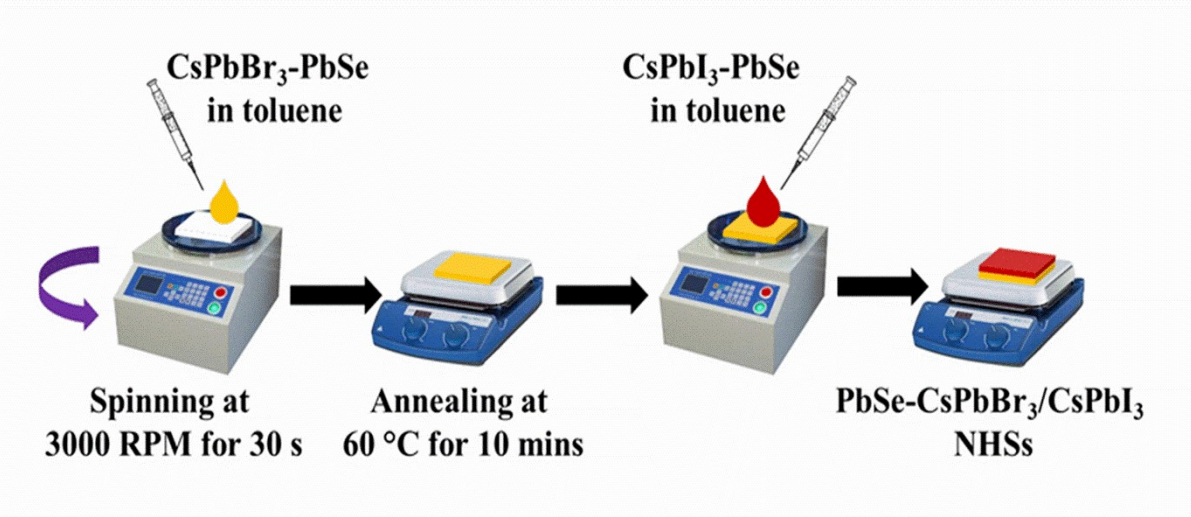

Figure S3. Schematic illustrating the sequential deposition of two perovskite layers on a glass substrate using spin coater.

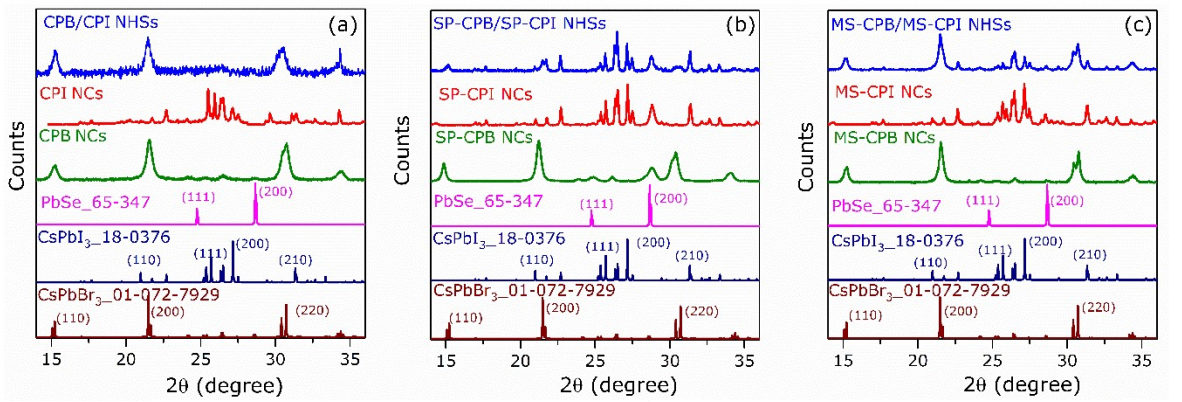

Figure S4. (a-c) PXRD pattern of pristine CPB, SP/MS-CPB, CPI, SP/MS-CPI and their corresponding heterostructures along with their reference pattern.

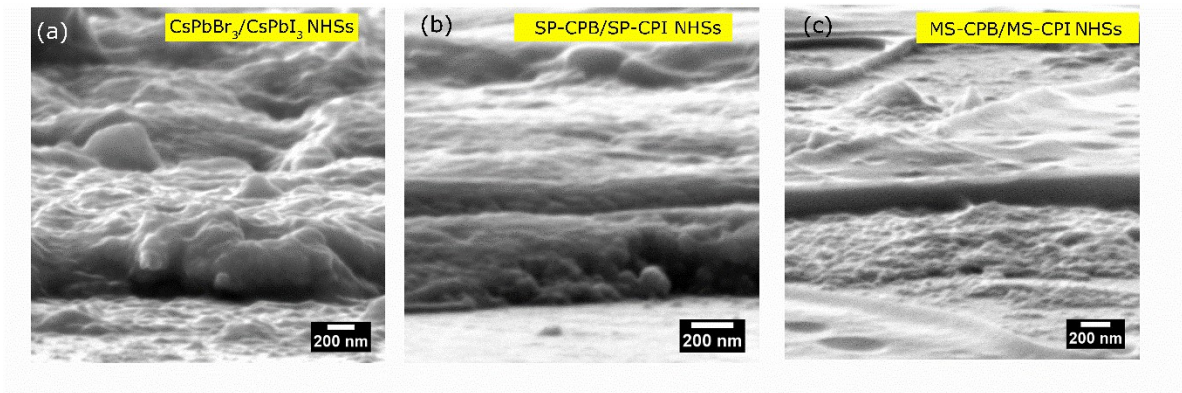

Figure S5. (a-c) Cross-sectional FESEM image of CPB/CPI NHSs, SP-CPB/SP-CPI NHSs, and MS-CPB/MS-CPI NHSs, respectively.

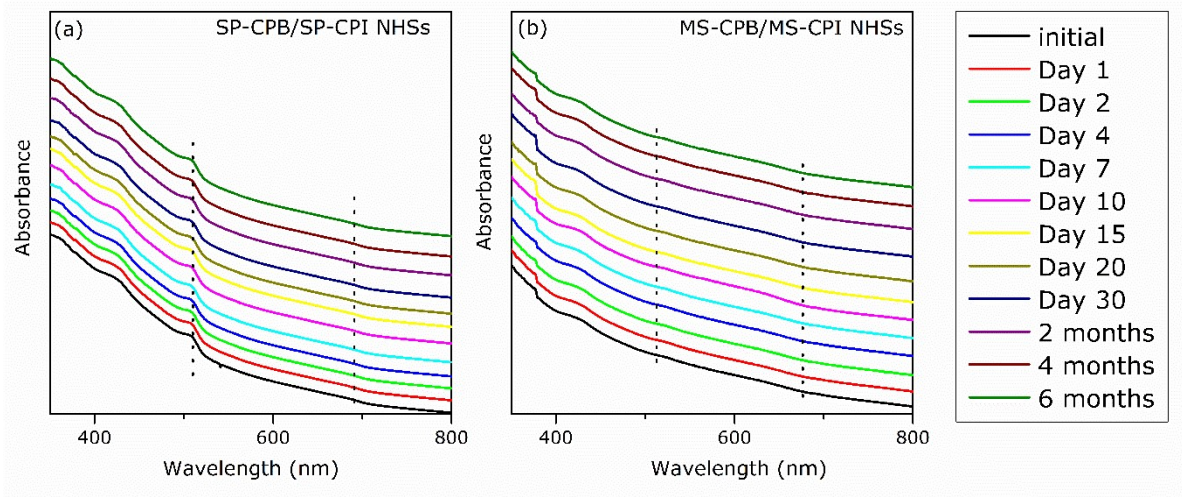

Figure S6. (a), (b) Absorption Spectra of SP-CPB/SP-CPI and MS-CPB/MS-CPI NHSs over

the course of six months, showing no evidence of halide intermixing, whereas the control sample is completely mixed almost instantaneously.

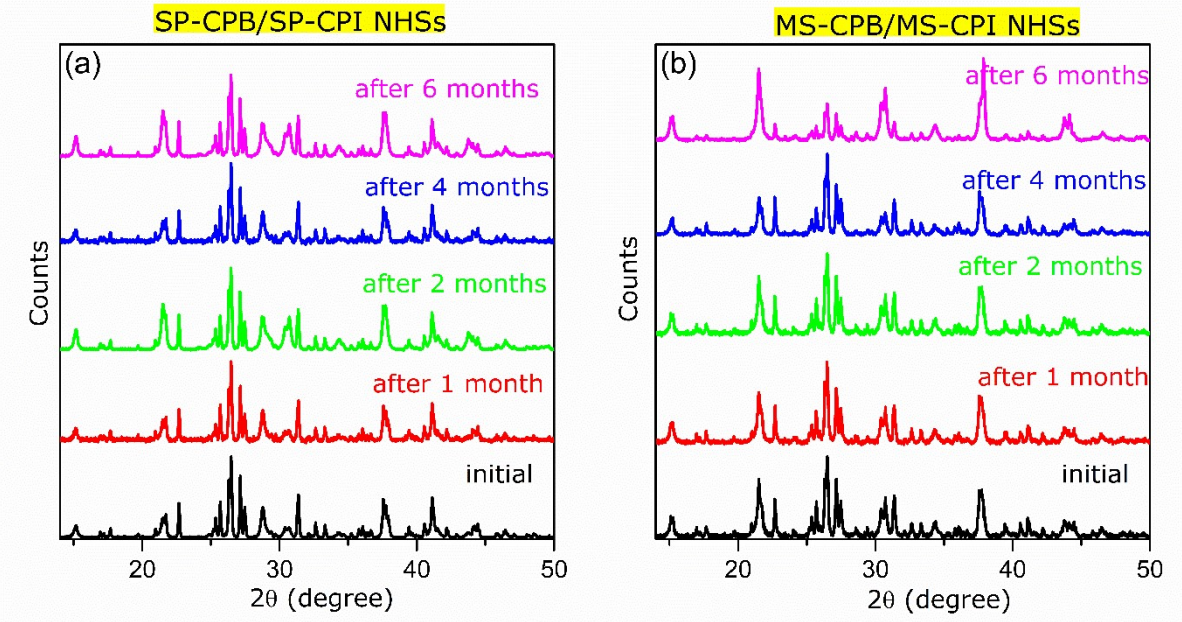

Figure S7. (a), (b) PXRD pattern of SP-CPB/SP-CPI and MS-CPB/MS-CPI NHSs collected for a span of six months. The PXRD pattern corresponding to NHSs is stable for even after six months, which shows the highly crystalline stability of the NHSs.

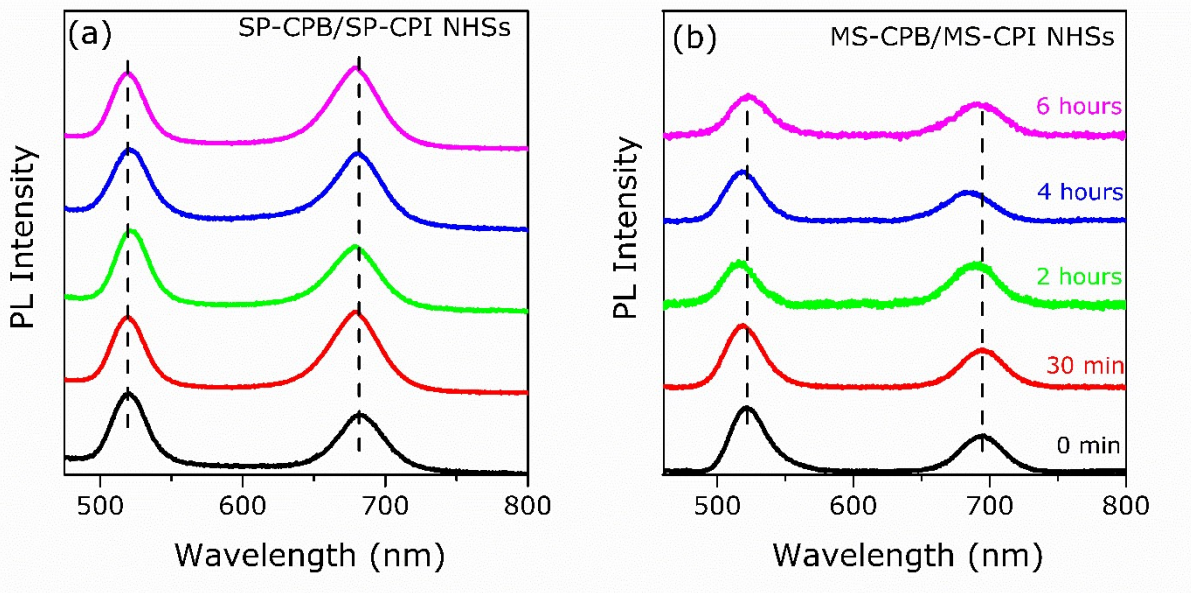

Figure S8. Evolution of emission spectra with time upon heating at 100 °C **(a)** SP-CPB/SP-CPI NHSs; **(b)** MS-CPB/MS-CPI NHSs.

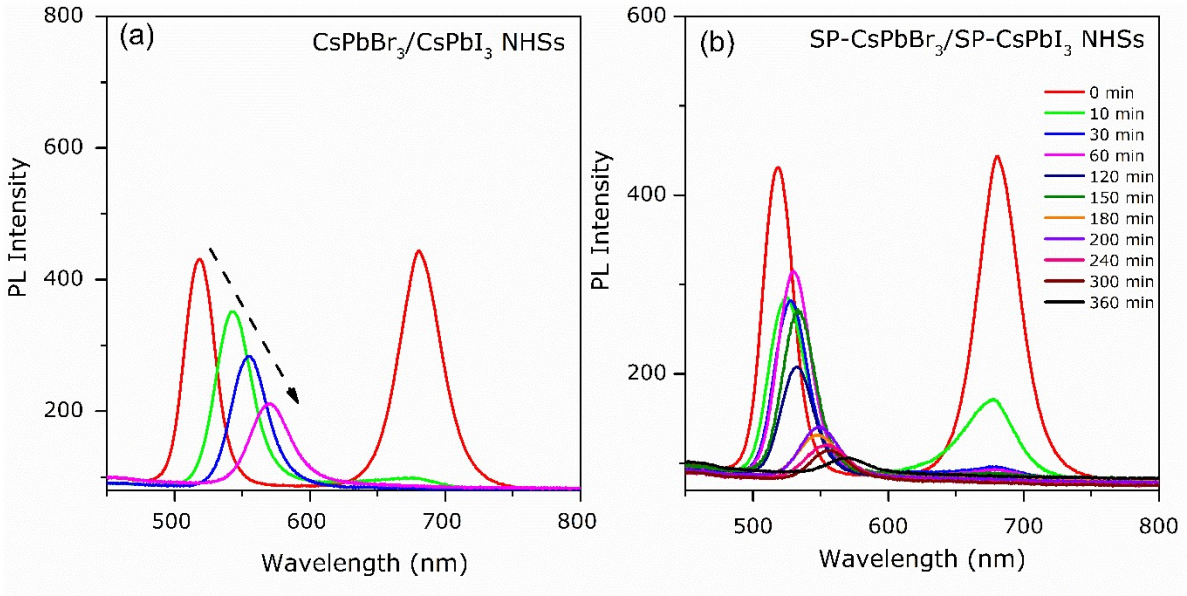

Figure S9. Change in the PL emission spectra of **(a)** pristine $CsPbbr_3/CsPbI_3$ NHSs in toluene; **(b)** SP-$CsPbBr_3$/SP-$CsPbI_3$ NHSs in toluene.