# Supporting information

## Unveiling the Degraded Electron Durability in Reduced-Dimensional Perovskites

Yu Lu,[1] Yang Shen,[1,*] Yan-Qing Li,[2,*], Kong-Chao Shen,[1] Wei Zhou,[1] Jian-Xin Tang[1,3,*]

[1] Institute of Functional Nano & Soft Materials (FUNSOM), Jiangsu Key Laboratory for Carbon-Based Functional Materials & Devices, Soochow University, Suzhou, Jiangsu 215123, China

[2] School of Physics and Electronics Science, Ministry of Education Nanophotonics and Advanced Instrument Engineering Research Center, East China Normal University, Shanghai 200062, China

[3] Macao Institute of Materials Science and Engineering (MIMSE), Macau University of Science and Technology, Taipa 999078, Macao, China

* Corresponding authors. E-mail addresses: 18862344930@163.com (Y. Shen), yqli@phy.ecnu.edu.cn (Y.-Q. Li), jxtang@suda.edu.cn (J.-X. Tang)

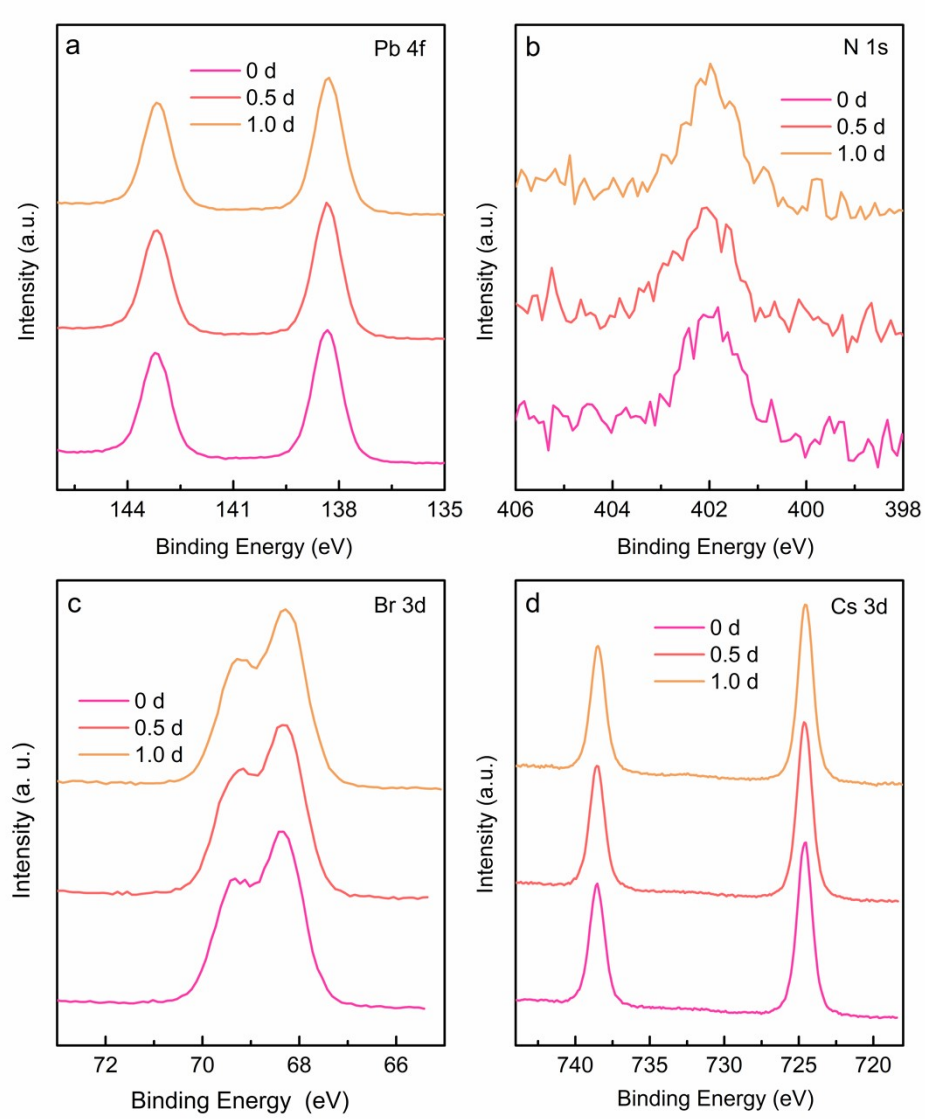


**Figure S1.** Vacuum stability of the $PEA^+$-doped $CsPbBr_3$ film. XPS spectra from the orbitals of a) Pb 4f, b) N 1s, c) Br 3d, and d) Cs 3d with respect to storage periods.

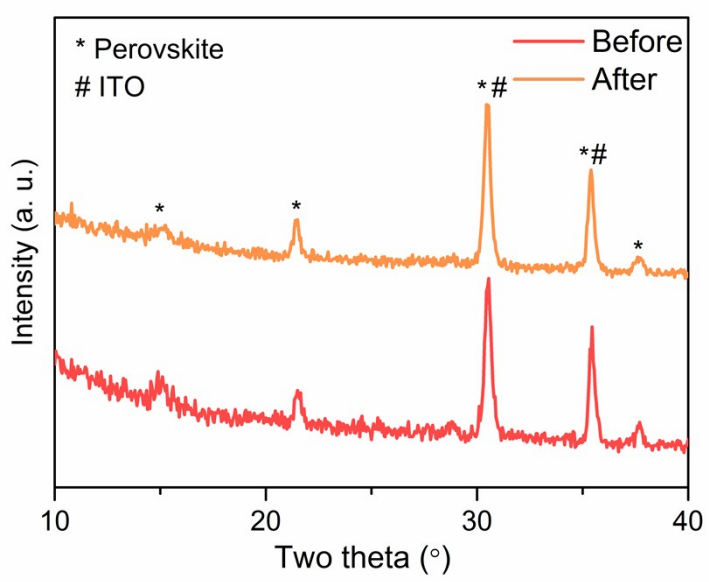


**Figure S2.** XRD patterns of the $PEA^+$-doped $CsPbBr_3$ film before and after electron radiation.

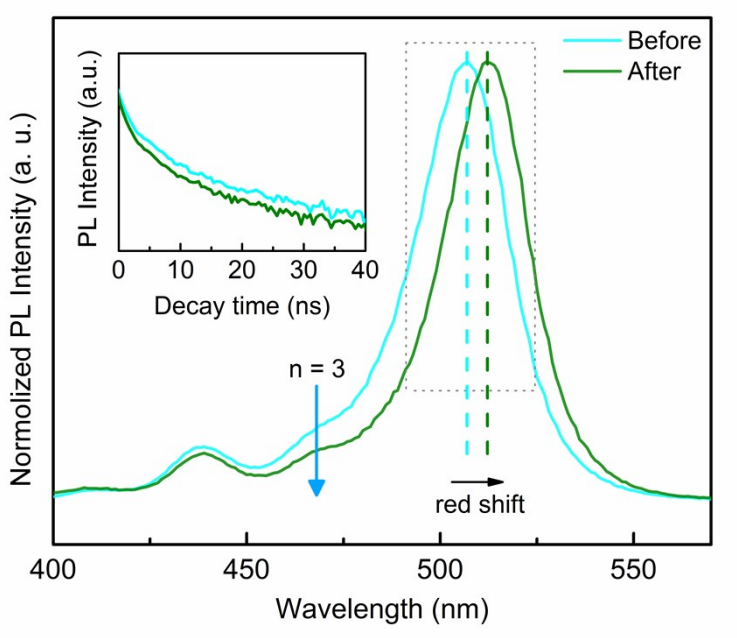


**Figure S3.** Steady PL spectra of the $PEA^{+}$-doped $CsPbBr_3$ film before and after electron radiation. Insert is the corresponding transient PL decay curves.

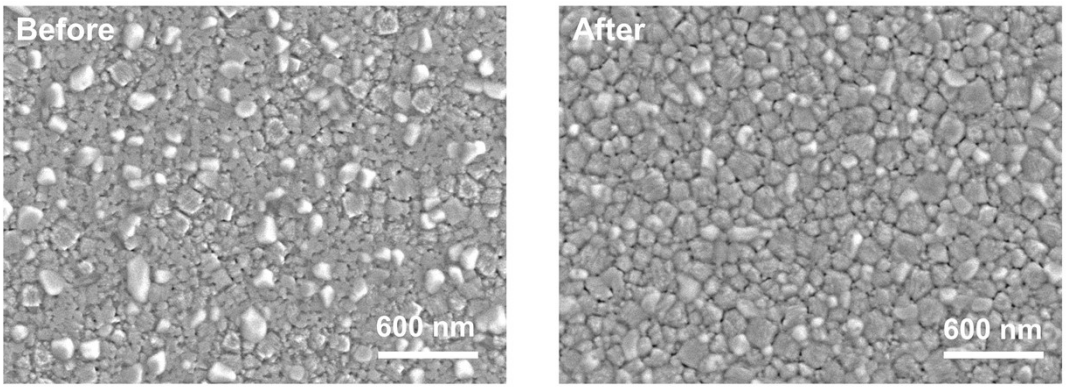


**Figure S4.** SEM images of the $PEA^+$-doped $CsPbBr_3$ film before and after electron radiation.

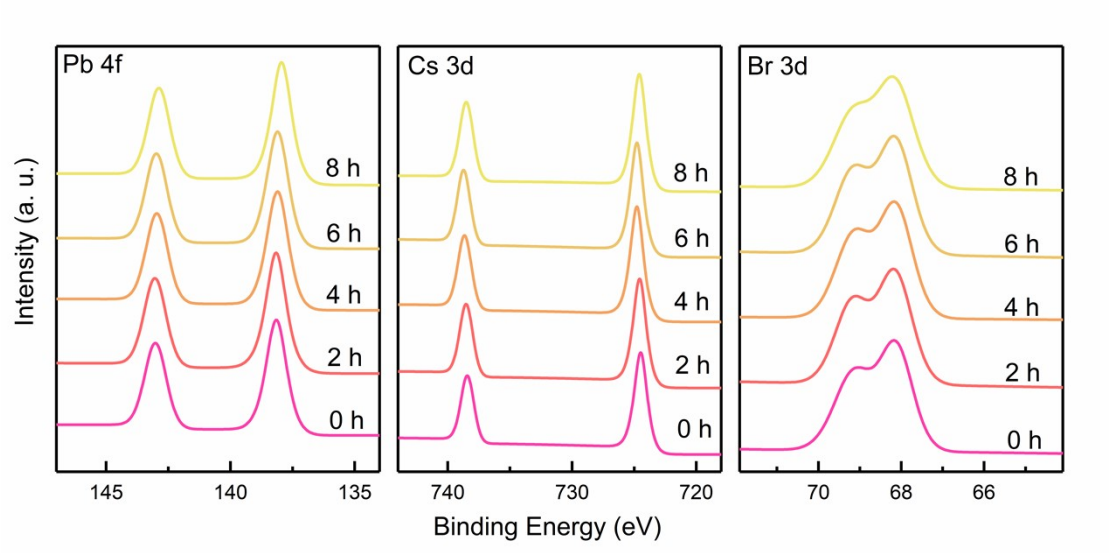


**Figure S5.** In situ XPS spectra of the elements in 3D $CsPbBr_3$ film with increasing radiation time.

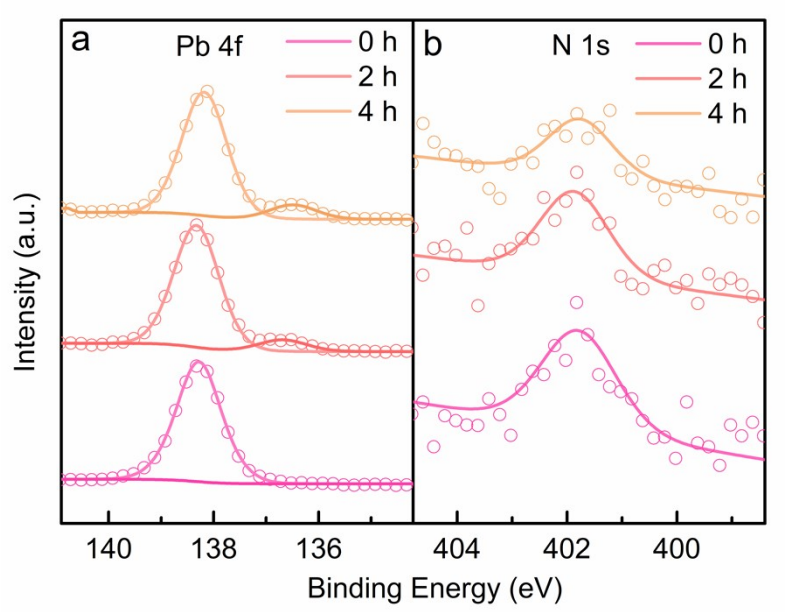


**Figure S6.** In situ XPS spectra from the orbitals of Pb 4f and N 1s in the $PEA^{+}$-doped $CsPbBr_3$ film with increasing radiation time.

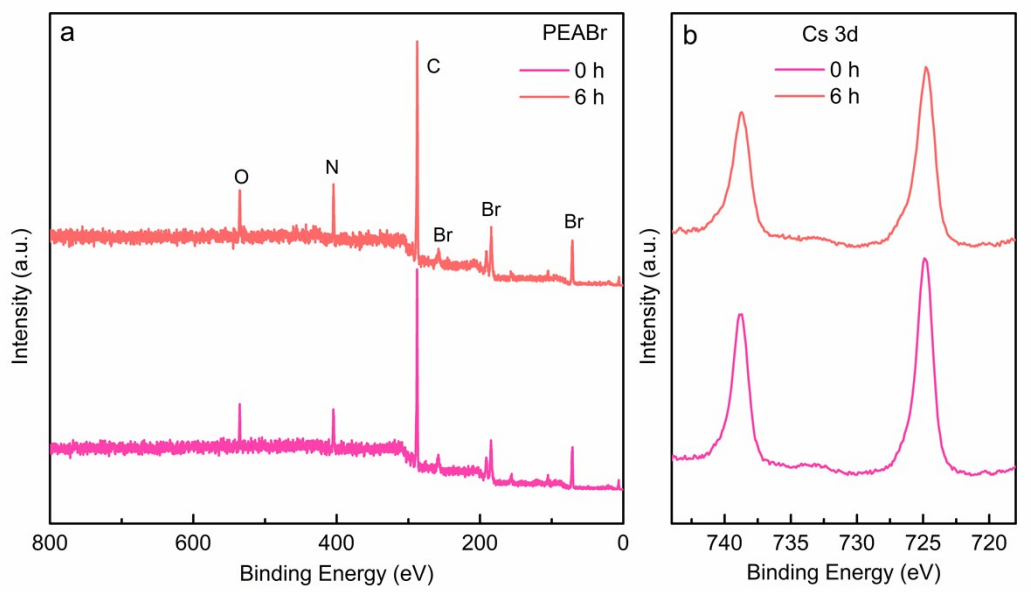


**Figure S7.** Stability test. a) Vacuum stability of PEABr film. b) Electron durability of CsBr film.

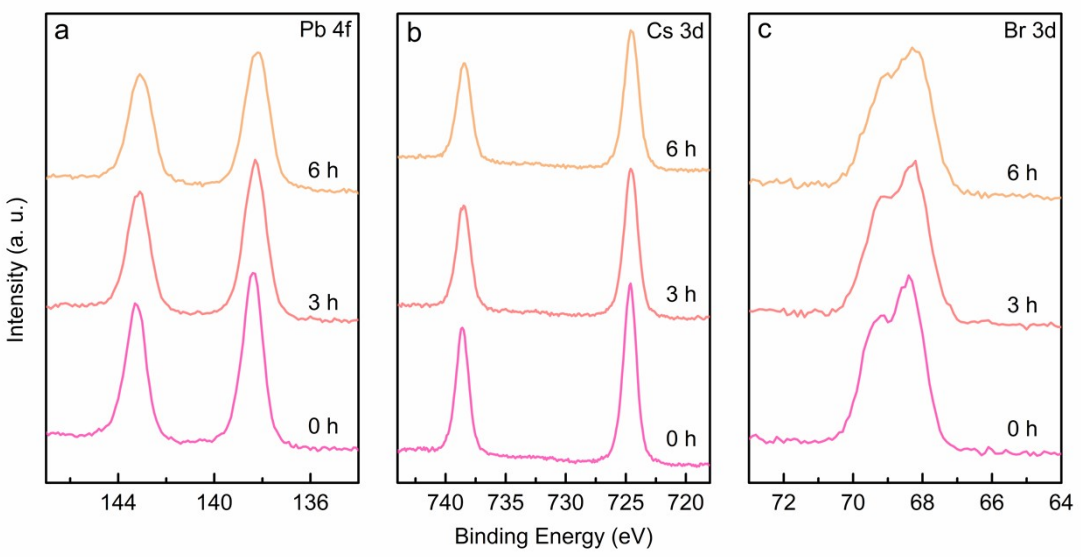


**Figure S8.** In situ XPS spectra of the elements in 3D $CsPbBr_3$ film under electron radiation after storage in ambient air over 30 min.

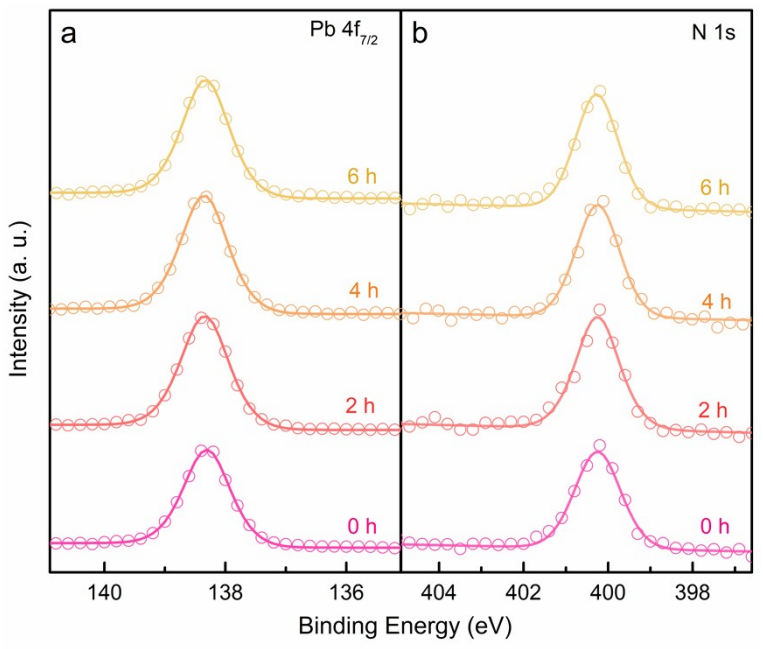


**Figure S9.** In situ XPS spectra from the orbitals of a) Pb $4f_{7/2}$ and b) N 1s in 3D $FAPbBr_3$ film with increasing radiation time.

**Table S1.** The integrated XPS spectral areas of the components in $PEA^+$-doped $CsPbBr_3$ film.

| Time (h) | $Pb^{2+}$ | $Pb^0$ | PEA | Cs | Br |
|---|---|---|---|---|---|
| 0 | 25451.1 | 0 | 1563.7 | 75155.1 | 10076.3 |
| 2 | 25290 | 2560.4 | 1212.9 | 86800 | 10187 |
| 4 | 25726.6 | 3060 | 766.5 | 91582.8 | 10370.4 |

**Table S2.** The integrated XPS spectral areas of the components in $PEA^+$-doped $FAPbBr_3$ film.

| Time (h) | $Pb^{2+}$ | $Pb^0$ | FA | PEA |
|---|---|---|---|---|
| 0 | 26789.3 | 0 | 7258.7 | 4667.9 |
| 2 | 28964.9 | 2285.6 | 7949.7 | 3979.1 |
| 4 | 29581.5 | 3139.4 | 9187.9 | 3751.7 |
| 6 | 30487.2 | 3919.2 | 9522 | 3368.1 |