Response to Reviewer 1 Comments

We really thank the reviewer for reviewing this manuscript. Our modifications and clarification in response to the reviewer’s comments are listed in the following.

**Point 1:** In label of Table 1, tau symbols are missing.

**Response #1:** Thanks for the reviewer’s comments. Tau symbols have been added in Table 1.

**Point 2:** The author explained that PbI$_2$ can passivate the grain boundary of the perovskite grain. However, PbI$_2$-rich perovskite layer has smaller grain size compared to pure perovskite layer. Is it possible to passivate the pure perovskite layer by additionally coating the PbI$_2$ solution on the pure perovskite layer, like the post-coating layer?

**Response #2:** Thanks for the reviewer’s kind suggestion. We agree that a post-coating layer of PbI$_2$ on the pure perovskite layer may show some passivation effects. However, the passivation effects may not be as good as the homogeneously mixed PbI$_2$ and perovskite. Since the PbI$_2$ would only contact the surface of the pure perovskite and the passivation effects could be limited. Meanwhile, pure perovskites are shown to be sensitive to heat and strong light illumination, and the formation of a homogeneously mixed PbI$_2$/Perovskite layer could also be more effective to prevent the perovskite decomposition, and enhance the stability of perovskite.

**Point 3:** As shown in Figure 3d, the photocurrent is higher at the grain boundary. Even though the grain boundary is passivated by PbI$_2$, but still grain boundary where the recombination rate is higher than that in the bulk. Why is the photocurrent at the grain boundary is higher than that at the center of single-crystalline perovskite grain?

**Response #3:** Thanks for the reviewer’s comments. Compared with the centre of single-crystalline perovskite grain, carriers are more likely to transfer along the grain boundaries or surfaces in polycrystalline perovskite film. Our results show that when the grain boundary is passivated by PbI$_2$, the defects at grain boundaries can be reduced which results in more photogenerated charge carriers transferring along the grain boundaries. Therefore, the photocurrent at the grain boundary becomes further enhanced compared with the centre of single-crystalline perovskite grain.

**Action taken:** To make the discussion clearer, we have revised the corresponding sentences on page 6 Line 190-196:

“… which could be due to the grain boundaries passivation effect of PbI$_2$. When the grain boundary is passivated by PbI$_2$, the defects at grain boundaries can be reduced, resulting in more photogenerated charge carriers transferring along the grain boundaries. Therefore, the photocurrent at the grain boundary becomes further enhanced compared with the center of single-crystalline
perovskite grain (as shown in Figure 3d). In addition, the current photoresponse at 1 V is extracted as shown in Figure 3e, which clearly demonstrates a higher current density in the PbI$_2$ rich perovskite thin film.”

**Point 4:** In page 6 line 200-202, the two sentences should be connected by “;”, not “.”.

**Response #4:** Thanks for the reviewer’s comments. In the revised manuscript, we replaced “.” by “;”.

**Point 5:** Why is the dark current of Figure 5b is two orders lower than that of Figure 4b at ±4V?

**Response #5:** Thanks for the reviewer’s comments. In Figure 4b, we showed the photocurrent of different devices under light illumination and the corresponding dark currents of these devices are shown in Table 2, which are close to the dark current of Figure 5b (~10$^{-8}$A or ~10$^{-2}$μA).