The authors present a study of hybrid ZnO electron transport layers with down conversion complexes. The benefit for two different types of polymer solar cells is demonstrated. Power conversion efficiencies are improved and higher stability of the devices is claimed.

**Question 1:** It is not clear for what kind of devices (PTB7-Th or PBDB-T-2F) the long term study in Figure 9 has been carried out. As no error bars are shown for the measurements I conclude that only one type of device has been investigated. The has to be specified. This refers also to the abstract (line 26). Of course it would be best to add the long term experiment for the second type of polymer solar cells. If this is not possible one should be more careful with a general conclusion.

**Answer:** Thank you very much for the kind suggestion. In this work, we mainly studied the effect of ZnO:ETP interlayer on the photovoltaic performance and stability of PSCs. In the study of PBDB-T-2F: IT-4F devices, due to the emission spectrum of ETP complexes and the absorption spectra of PBDB-T-2F can be well matched, we mainly discuss the improvement of photovoltaic performance of ZnO:ETP devices as a supplementary explanation. We apologize for the inaccuracy of some of the statements in the manuscript, and have modified them in Page 1 (line 25) of the manuscript.

Besides, in the research on PTB7-Th:PC71BM device, the stability of the device based on ZnO:ETP layer is prolonged by 70% compared to the ZnO device. The results suggest that the ZnO:ETP layer plays the role of enhanced photovoltaic performance and prolonged device stability as well as reducing photo-loss and UV degradation for PSCs.

**Figure 9.** PCEs decay curves of the ZnO and ZnO:ETP device (based on PTB7-Th:PC71BM) stored in 17 days in N2 filled glove box.

**Question 2:** In line 75 it is referred to previous work with an increase of PCEs by 13.7% without citation. However, the increase by 13.7% is also the claim for this publication (line 271), so rephrasing seems to be necessary.

**Answer:** Thank you very much for the kind suggestions. We are very sorry for this mistake, we have corrected the relevant description in Page 2 (line 78) of the manuscript and adjusted the structure of the introduction appropriately. The corrections in the manuscript are as follows:
 Typically, Eu(TTA)$_3$phen (ETP) luminescent complexes have irregular structures and large size differences, which are not ideal when applied to a precise structure of PSCs. Hence, it is necessary to adjust the size and distribution of ETP complexes by changing the concentration of the complexes to optimize the photovoltaic performance of PSCs.

In this work, we constructed simple and effective way to regulate the size of solid micelles of rare earth complexes and then applied them to polymer solar cells to increase the photoelectric conversion efficiency.

**Question 3:** The scheme in Figure 1 is exclusively for the PTB7-Th type of device. Why is the description of the second type of device (PBDB-T) missing?

**Answer:** This is a very good question. In this work, we mainly studied the effect of ZnO: ETP interlayer on the photovoltaic performance and stability of PSCs. The PBDB-T-2F: IT-4F system was added to show that ZnO: ETP interlayer can improve the photovoltaic performance by extending the spectral response range of solar cells. In addition, we show the absorption spectral of PBDB-T-2F in Figure 10, which shows that PBDB-T-2F can absorb red light from re-emission of ZnO: ETP. We have added a discussion about PBDB-T-2F on page 13(line 361) of the manuscript.

**Question 4:** Concerning the degradation of polymer solar cells also the influence of morphological degradation has to be mentioned. This has been demonstrated in a number of studies including the PTB7-Th:PC$_{71}$BM system with DIO as a solvent additive:

https://doi.org/10.1021/acsenergylett.8b02311

But again, the kind of device measured and presented in the plot of Figure 9 has to be specified.

**Answer:** Thank you very much for your good suggestions. In the description of polymer solar cell degradation[6] on page 1(line 39), we added a reference to the effect of morphological degradation and added a related citations.


**Question 5:** The caption of Figure 10 the meaning of arrows and red circles should be given. Although both systems are put into the figure, the discussion is reduced to the PTB7-Th system (line 337).

**Answer:** Thank you very much for your good suggestions. We have added a description of the red circles and arrows in Figure 10 and added a discussion about PBDB-T-2F on page 13(line 361) of the manuscript. The corrections in the manuscript are as follows:

In particularly, PTB7-Th has a strong absorption at 550-750 nm, and PBDB-T-2F has a strong absorption at 400-700nm. The absorption spectra of these two donor materials are match well with the red light (612 nm) re-emitted by the ETP complexes, so this red light can be absorbed by the active
Therefore, the ETP down-conversion material can effectively enhance the photoelectronic response of PSCs, extending the spectral response range of the PSCs to the UV region.

**Figure 10.** UV-visible absorption spectra of ETP, PTB7-Th:PC71BM and PBDB-T-2F:IT-4F (The red circle symbolizes the peak position in the ETP emission spectrum; the arrow symbolizes that UV light and visible light are absorbed by the ETP and active layer materials, respectively).

In particularly, PTB7-Th has a strong absorption at 550-750 nm, and PM6 has a strong absorption at 400-700nm. The absorption spectra of these two donor materials are match well with the red light (612 nm) re-emitted by the ETP complexes, so this red light can be absorbed by the active materials. Therefore, the ETP down-conversion material can effectively enhance the photoelectronic response of PSCs, extending the spectral response range of the PSCs to the UV region.