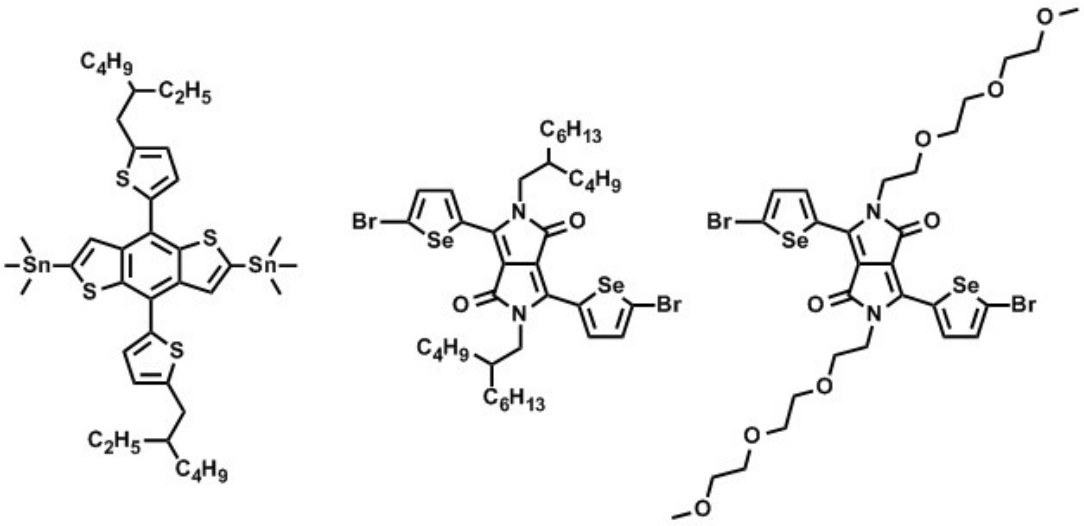
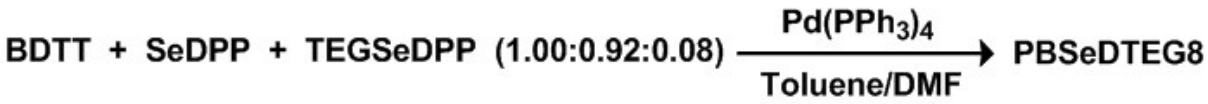
Supporting Information





Synthesis of TEGSeDPP: The synthesis of **TEGSeDPP** followed the same route as the literature reported (*Adv. Energy Mater*. **2014**, *4*, 1300864), excepted the selenophene-substituted DPP was used.

Synthesis of PBSeDTEG8 (PBDSe3): **BDTT** (0.1809 g, 0.2000 mmol), **SeDPP** (0.1635 g, 0.1840 mmol) and **TEGSeDPP** (0.0135g, 0.0160 mmol) were dissolved into 10 mL toluene and 1 mL DMF in a flask protected by argon. The solution was flushed with argon for 10 minutes, then 10 mg of $Pd(PPh_3)_4$ was added into the flask. The solution was flushed with argon again for another 10 minutes. The oil bath was heated to 115 ºC gradually, and the reaction mixture was stirred for 10 hours at 115 ºC under argon atmosphere. Then, the mixture was cooled down to room temperature and the polymer was precipitated in ~100 ml methanol and the precipitated solid was collected and purified by silica gel chromatography using chloroform as eluent. The polymer was obtained as dark green-black solid, yield 30%. The polymer can be readily dissolved into chloroform, chlorobenzene or dichlorobenzene, etc**.**

Device layout

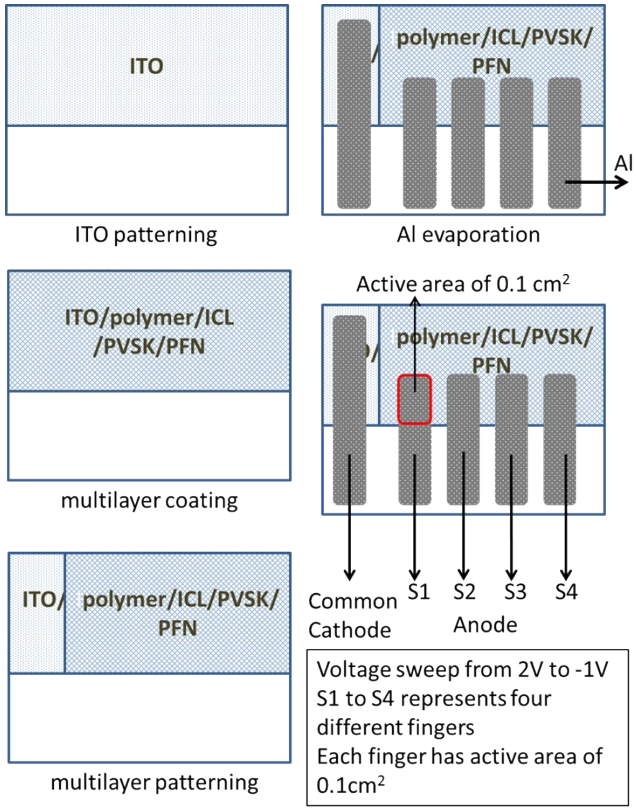


Fig. S1. The device layout and *J-V* measurement details for the actual devices.

Single junction devices simulating the optical interference inside hybrid tandem structure

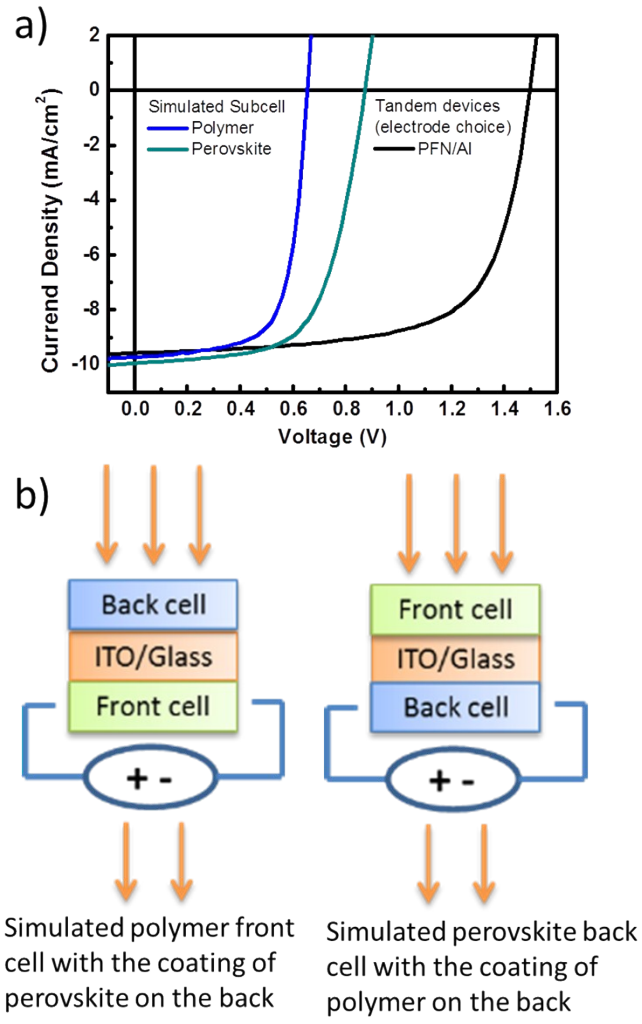


Fig. S2. *J-V* measurement of the single junction devices simulating the subcells in the hybrid tandem structure. When measuring polymer front cell, we can coat a layer of back cell on the back of the ITO/Glass, thus part of incident is filtered before reaching the polymer absorber, *vice versa* for perovskite back subcell.