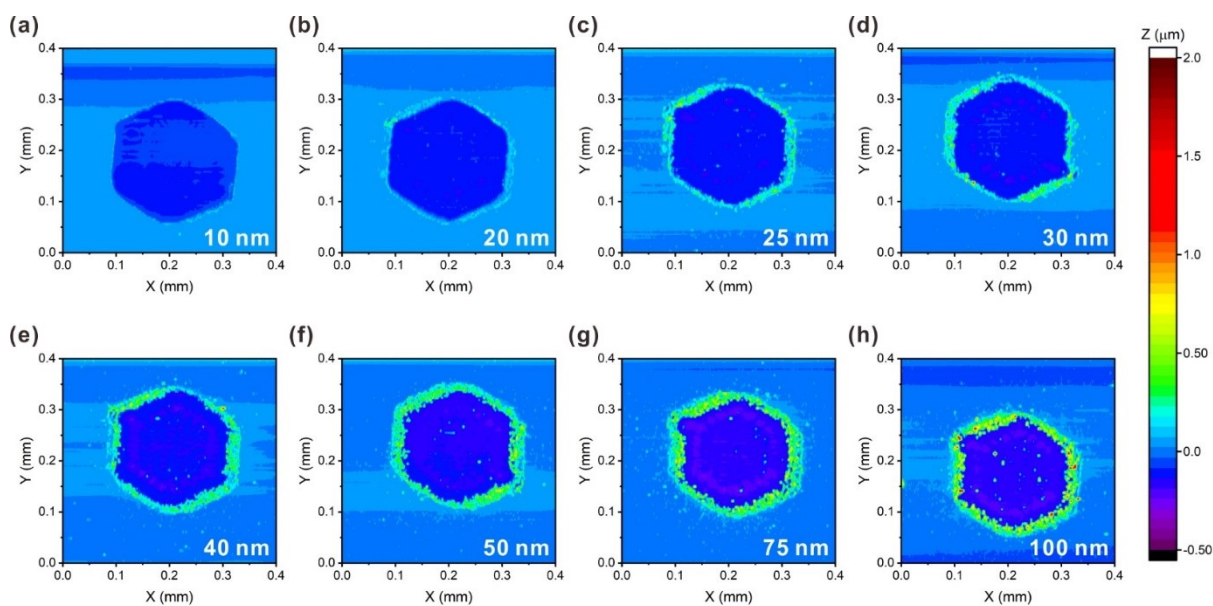
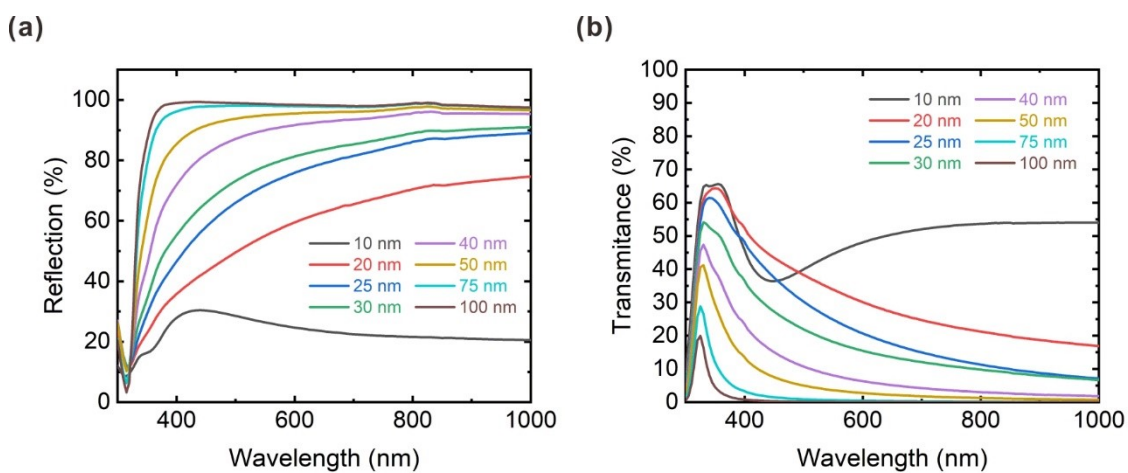


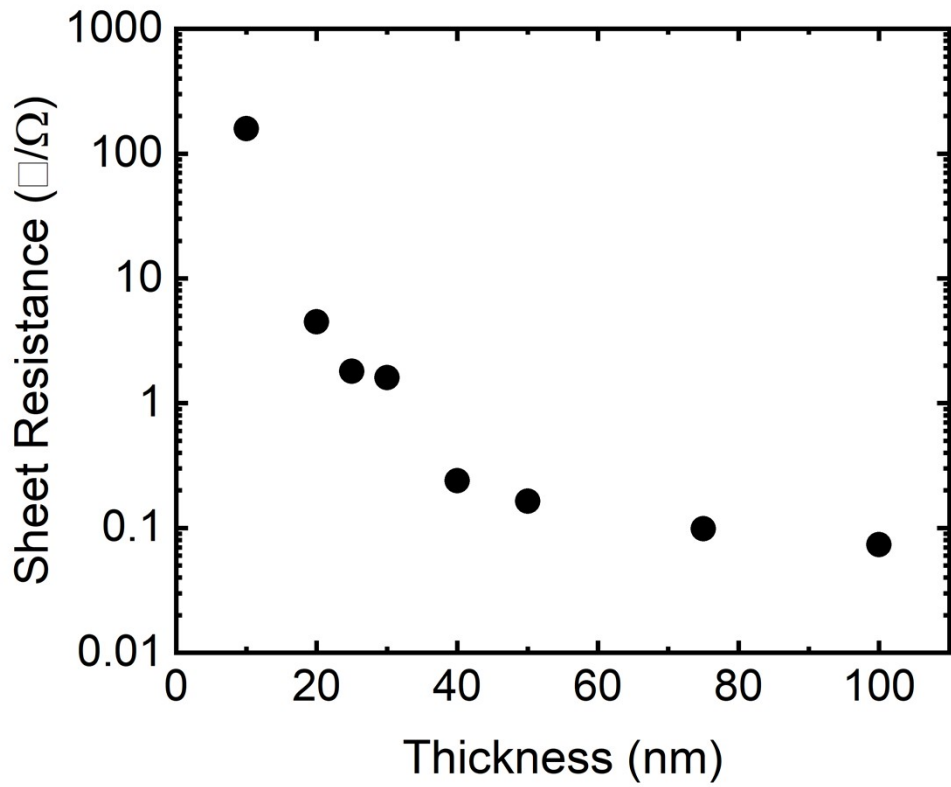
## Supporting Information



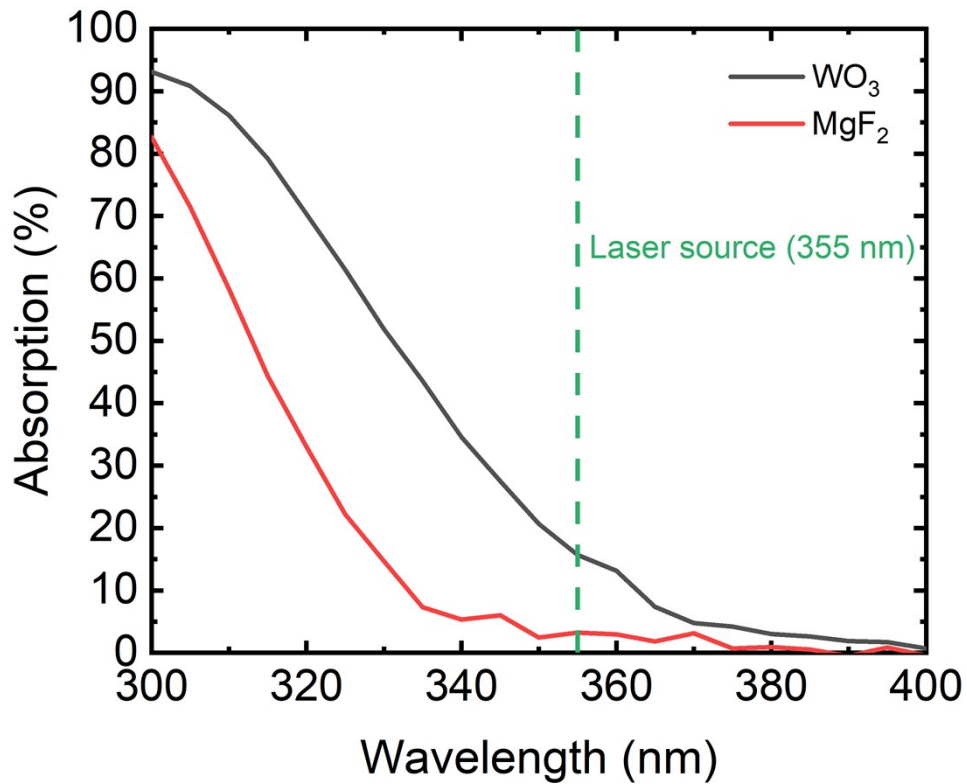
**Figure S1.** The  $\alpha$ -step mapping figure with the different silver thickness after laser cutting.



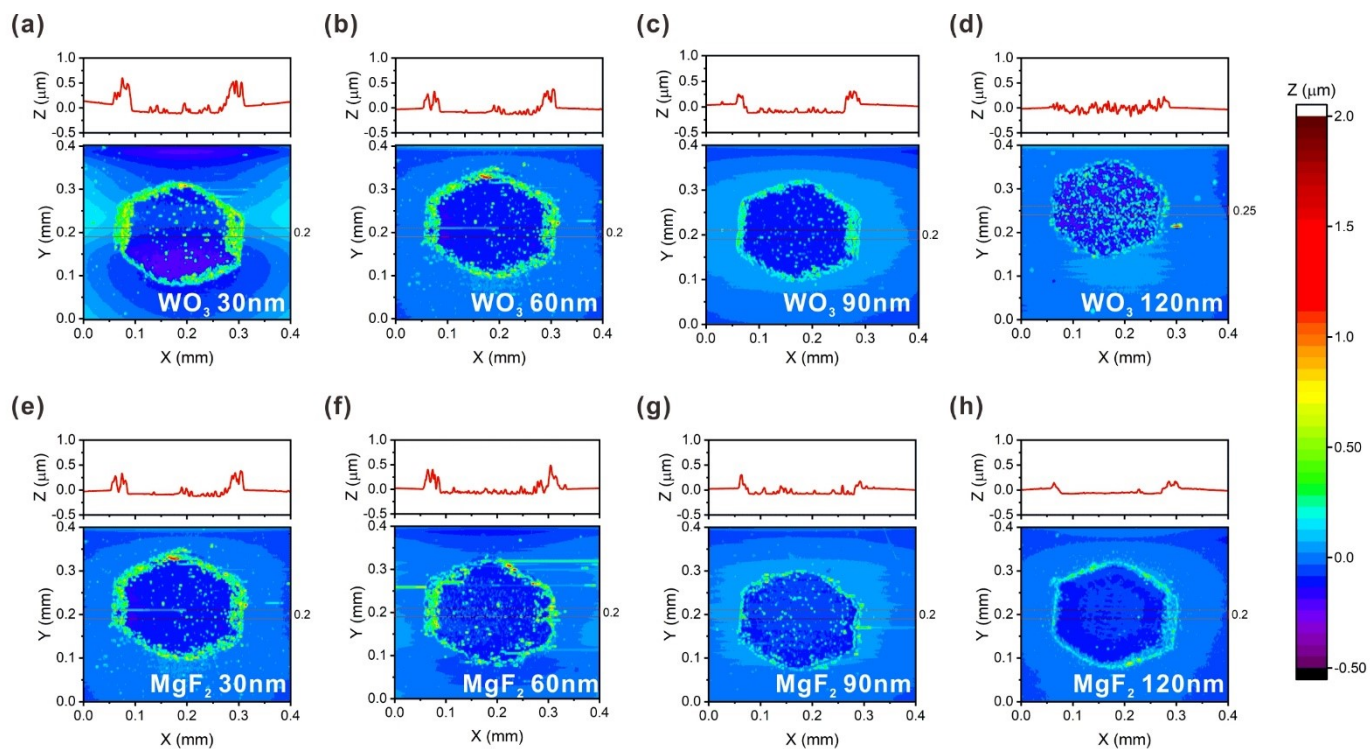
**Figure S2.** (a and b) The reflection and transmittance trend with silver film in different thickness.



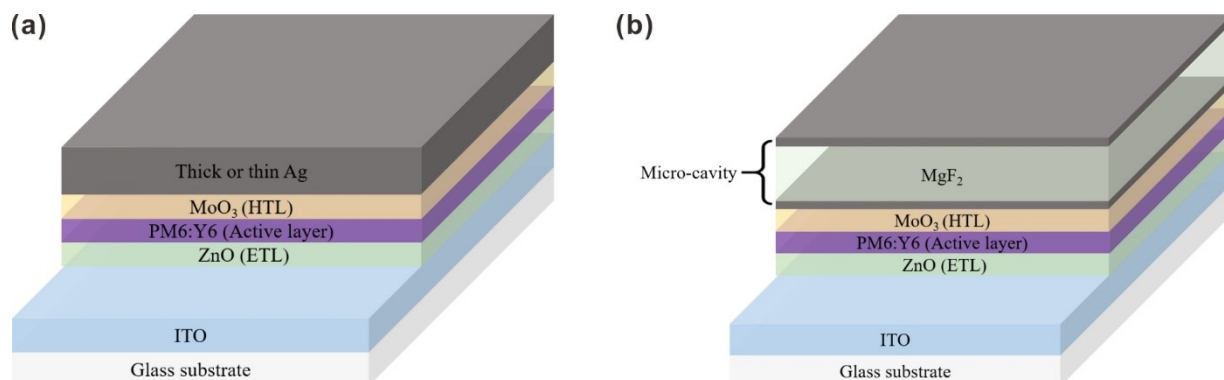
**Figure S3.** The sheet resistance trend with silver film in different thickness.



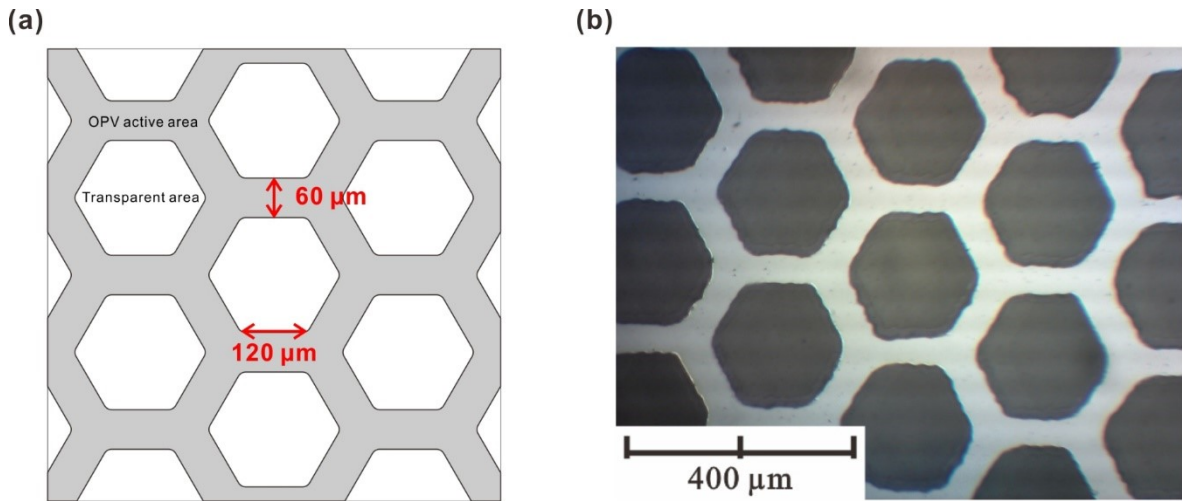
**Figure S4.** The thin film absorption trend with  $\text{WO}_3$  and  $\text{MgF}_2$  in 100 nm condition.



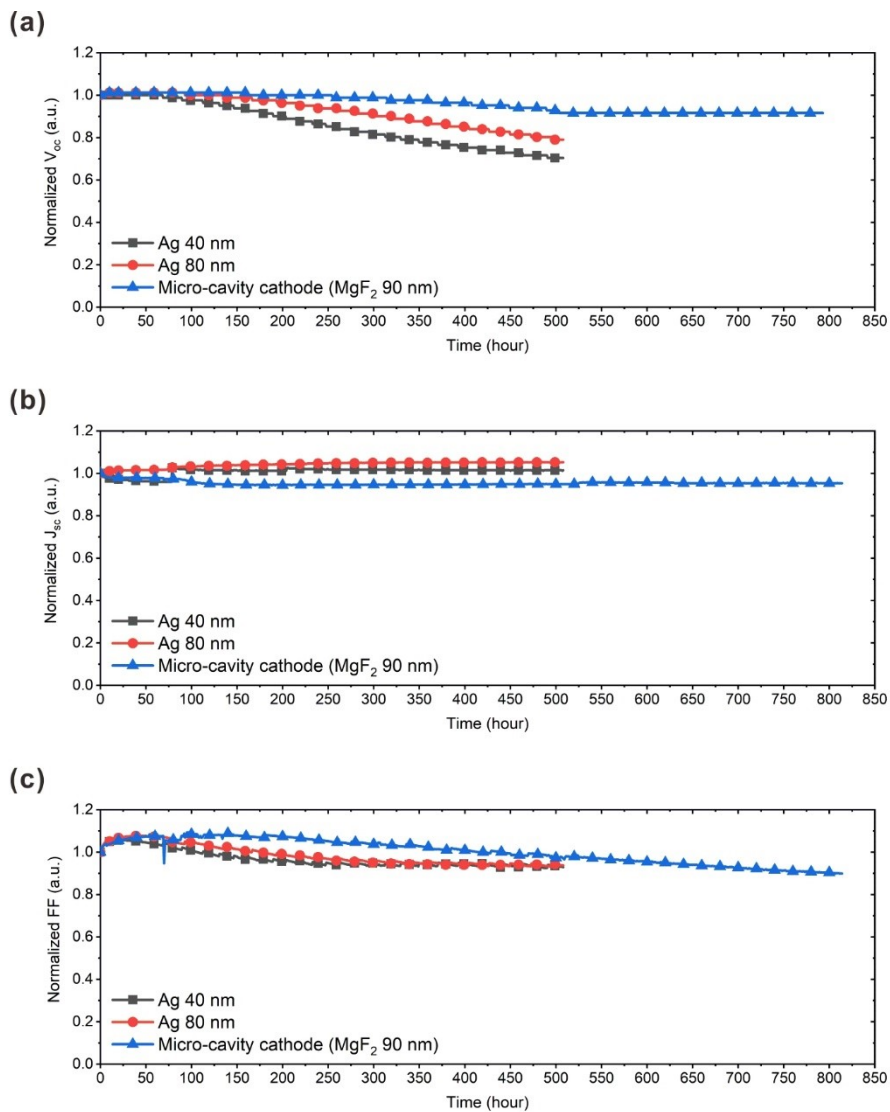
**Figure S5.** The  $\alpha$ -step mapping and cross-sectional with the dielectric materials of (a-d)  $\text{WO}_3$ , and (e-h)  $\text{MgF}_2$  across different thicknesses.



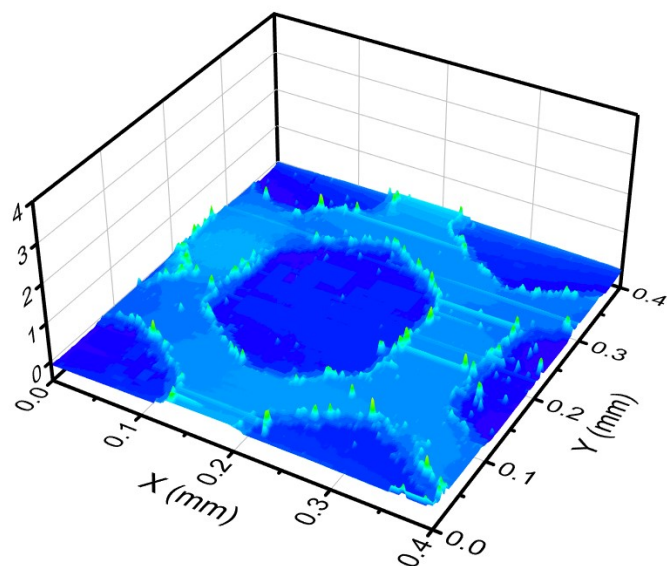
**Figure S6.** Schematic diagram of an organic photovoltaic device structure with (a) thick or thin Ag, (b) micro-cavity cathode.



**Figure S7.** (a) Schematic structure illustrating the TPV pattern design. (b) Optical microscopy images of the TPVs after laser process.



**Figure S8.** (a)  $V_{oc}$ , (b)  $J_{sc}$ , (c) FF vs. aging time under 1 sun simulated AM1.5G illumination with different cathodes.



**Figure S9.** TPVs  $\alpha$ -step mapping with the thin Ag 40 nm cathodes.