Supplementary Information

The contact angles on ZnO layer, ZnO/SADM, and ZnO/ILMs were measured, as shown in Fig S1. The surfaces of ZnO/SADM (70 °) and ZnO/ILMs (25 °) were more hydrophobic than that of pristine ZnO (17 °) as shown in Figure S3. The contact angle results combined with the results of atomic force microcopy (AFM) images (Fig. 2) confirm the formation of uniform monolayers of ILMS and SADM on the ZnO layers.

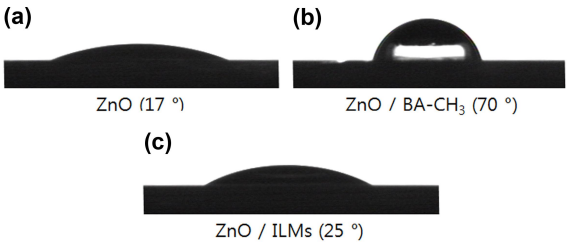

Figure S1. Contact angles on ZnO layer (a) without modification or with (b) SADM and (c) ILMs modification.

Time response of luminance (L) and luminous efficiency (LE) in HyPLEDs with and without surface modification of the ZnO layer using SADM (BA-CH_3) and ILMs was investigated under a continuous bias of 11 V; the values of L and LE didn't change significantly, as shown in Figure S2. It means that permanent self-aligned interfacial dipoles arise within ILMs layer, and they shift the vacuum level at that interface between ZnO and SY.

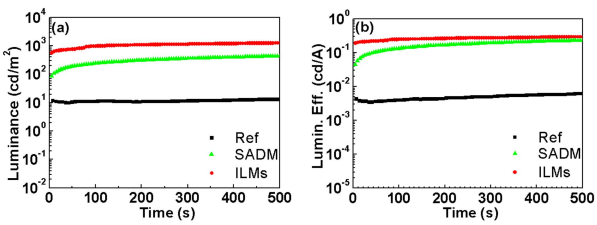

Figure S2. Time response of (a) L and (b) LE in HyPLEDs with and without surface modification of ZnO layer using SADM (BA-CH_3) and ILMs.

The EQE values of ZnO/P3HT hybrid solar cells with and without surface modification of ZnO layer using SADM (BA-CH_3) and ILMs were mesured in Fig. S3. The EQE value of P3HT/ZnO without interfacial layer showed the highest value, which is consistent with J_{SC}. The reason why J_{SC} and EQE values decreased by adding ionic liquid layer and self-assembled monolayer is the hindrance to direct charge transfer from P3HT to ZnO.

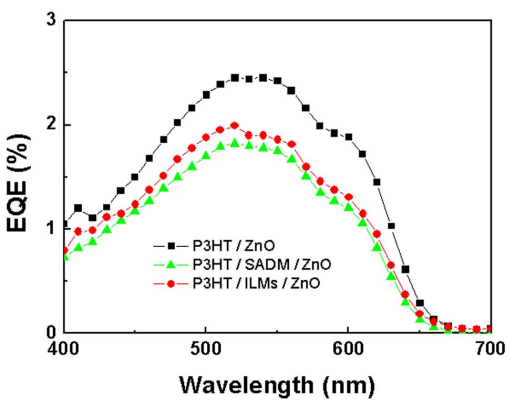

Figure S3. EQE of ZnO/P3HT hybrid solar cells with and without surface modification of ZnO layer using SADM (BA-CH_3) and ILMs.