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Transition metal complexes have been widely used as light-emitting and photon-absorbing materials in optoelectronic devices with diverse applications. While these complexes have been intensively studied in the field of organic light-emitting devices (OLEDs) due to their inherently high phosphorescence quantum yields ($\Phi$), they are rarely employed in the fabrication of organic solar cells (OSC) with reported examples showing poor photovoltaic responses with unexpectedly low power conversion efficiency (PCE) of $\leq 2.9\%$ for most of the vacuum-deposited devices or $\leq 5.0\%$ for solution-processed devices in the literature. Here, we successfully employed weakly luminescent gold(III) corrole, namely HKU-AuC, as photon-absorber which can effectively boost the PCE of OSCs to 6$\%$ under 1 sun AM1.5G simulated light illumination with high short-circuit current density of 14.2 mA cm$^{-2}$ and fill factor of 0.57, which is the highest value among the reported PCE for OSCs incorporating metal-organic complexes. The superior device performance may be ascribed to the weakly emissive nature with low $\Phi$ of 0.04$\%$ and long excited state lifetime of 63 $\mu$s of HKU-AuC, which can minimize recombination loss and favor exciton-dissociation. A broad absorption covering the entire visible spectral region has also been observed, which is originated from mixing excited states of triplet ligand-to-metal charge-transfer and singlet ligand-centered $\pi \to \pi^*$ transitions. These distinct features of HKU-AuC may account for the significant increase in the photocurrent and PCE of OSCs. More importantly, the $\Phi$ is suggested to play an important role affecting the PCE and can be used to rationalize the inferior OSC performance based on other phosphorescent organometallic complexes. This work demonstrates for the first time to employ gold(III) complex as donor and opens up a new avenue to fully utilize transition metals for the fabrication of OSCs.

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FIG 1. Mechanisms of the photoconversion in OSCs with triplet photoactive materials. $\eta_{\text{TOTAL}}, \eta_{A}, \eta_{\text{ED}},$ and $\eta_{\text{CC}}$ are the total, light-absorption, exciton-dissociation and charge-collection efficiencies, respectively.

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