Efficiency improvement of organic photovoltaic cells by harvesting triplet excitons

There has been a great effort to improve the efficiency of organic photovoltaic (OPV) solar cells. A solar cell produces electrical current from absorbed sunlight. In OPV, the absorbed sunlight generates an excited energy state called an exciton. There exist two kinds of excitons, singlet and triplet ones. Usually, OPV use only the singlets. The power conversion efficiency (PCE) of photovoltaic devices is limited by the short lifetime of singlet excitons, as they de-excite quickly and cannot be efficiently converted to electricity. To overcome this problem it is desirable to work with triplet excitons instead. These have a much longer lifetime, and can be converted to electrical current more easily. However, for this to work, a way must be found to produce triplets efficiently. For this purpose, we use the spin $\frac{1}{2}$ radical galvinoxyl blended into the bulk heterojunction photovoltaic device. Our devices show a roughly 30% enhancement in power-conversion efficiency compared to the device without galvinoxyl. Magneto-photocurrent (MPC) measurements were performed on galvinoxyl doped devices to unravel the underlying mechanism for the increase in PCE.