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Magnetic Study of Exciton-Charge Reaction in Organic Phosphorescence-Based Light-Emitting Diodes[1] MING SHAO, BIN HU, University of Tennessee — The capture of electron and hole leads to the singlet and triplet exciton formation at 1:3 ratio in organic light-emitting diodes (OLEDs) of fluorescent conjugated molecules. This significantly limits the quantum efficiencies of singlet light emission from OLEDs. The alternative option is to use triplet emission from phosphorescent molecules to ultimately increase the quantum efficiencies of OLEDs. In this report we will present our recent studies of triplet exciton-charge reaction in most efficient phosphorescence-based OLEDs by using magnetic field-dependent electroluminescence and excited state-related magnetoresistance. Our experimental results show that the electrically generated excitons can react with charge carriers with two consequences: detrapping charge carriers or splitting electrons and holes in excited states. Nevertheless, the triplet exciton-charge reaction presents a significant challenge to increase the quantum efficiencies of OLEDs towards the theoretical limit of 100%. Furthermore, we observed that the triplet-charge reaction can be adjusted by changing the balancing degree of bipolar electron and hole injection. Therefore, tuning the bipolar injection can forms a mechanism to control the triplet-charge reaction and to consequently improve the quantum efficiencies of phosphorescence-based OLEDs.

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