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Material, Device and Interfacial Engineering for High efficiency Solution Processable Organic Light Emitting Diode

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Generally, Organic LEDs can be fabricated using either vacuum deposition or wet processes. It is well known that vacuum deposition can produce high efficiency Organic LEDs. Solution processable organic light emitting diode offers simpler, cheaper method of fabrication which is compatible with the roll-to-roll and inkjeting process. However, generally solution processable LED suffers from poorer efficiency and the generally lack of materials in the market. Here, we demonstrate that by simple surface engineering, the efficiency of commercial available long lifetime 'super-yellow'poly-(p-phenylenevinylene) (SY-PPV) can be almost doubled. In order to obtain high efficiency solution processable Organic LEDs, molecules of size larger than 1000 molecular weight with triplet energy higher than 2.8eV are required. Hence, we have developed an accurate computational method to predict the triplet energies of materials allowing us to screen a wide range of materials. From here, we are able to synthesize materials with high triplet energies. We also found out that intermolecular distance and non-chromophoric side group substitutions such as bulky alky groups and fluorine can significantly influence the triplet energy. Effective charge confinement is also important to obtain charge balance for high efficiency Organic LEDs. Here we also demonstrated fully solution processable red, green blue organic phosphorescent light emitting diodes with little deviation of CIE colour coordinate within a wide range of brightness as a result of effective excitons and charge confinement.

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