High Efficiency Phosphorescent Organic Light-Emitting Devices

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Phosphorescent organic light emitting diodes (PHOLEDs) have been developed for more than 10 years.[1-2] As such efforts, the highly efficient PHOLED materials are now utilizing in commercial active-matrix organic light emitting diodes (AMOLEDs). Nevertheless, the development of much more efficient PHOLEDs is still being required due to the energy saving. In this talk, we present four main elements that directly affect the performance of red, green, and blue PHOLEDs: excitons confinement, charges trapping, dopant concentration and dopant molecular structure. They are not independent of each other but we attempt to present each of them in situations where its effect is individually predominant. For a good efficiency, the triplet energy of dopant molecules must be sufficiently confined within the emitting layer (EML). Second, charge trapping at the emissive layer that may be a source of luminescence may also be a source of inefficiency as it contributes to increase the driving voltage of the device. We prove how reducing charge trapping results in the efficiency in PHOLEDs. Concerning dopant concentration; we show that there is an ideal concentration for a maximum efficiency of the PHOLED. In fact, it is necessary the distance between host and dopant molecules remains within a certain range. This imposes natural conditions in the concentration and the distribution of the dopant molecules within the host matrix. Finally, we present the effects of molecular structure on the efficiency of the PHOLEDs using iridium complex dopant with different chemical modifications on the ligand. Chemical modification to block chromophore interactions not only reduces molecular self-quenching but also tune its highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) energies.

References

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2. D. F. O' Brien, et al., Appl. Phys. Lett. VOL 74, (1999), P.442

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