Lifetime of Organic Light-Emitting Devices Under Pulsed Voltage Operation

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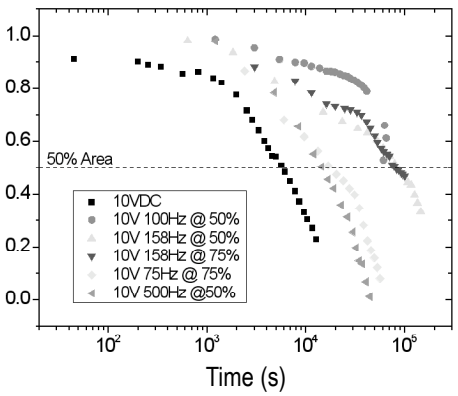

The useful lifetime of Organic Light-Emitting Devices (OLEDs) is limited by the formation and growth of non-emissive regions on the OLED surface. This deleterious effect germinates at the cathode/organic interface where the reactive metals used for the cathode are affected by atmospheric oxidizers such as moisture and oxygen. While many studies seek to understand the role of additional design elements, such as encapsulation, in slowing dark spot growth, this study focuses on the device driving conditions and their effect on device lifetime. Oxidation of the cathode material can be expedited by elevated operating temperatures and excited-state molecular reactions. Both of these aggravating elements occur under normal operation as charge is injected/extracted across the metal/organic interface. Under DC conditions, these factors are maximized as the constant current produces a high density of reactive molecular states and excess heat. By limiting the on-time of the device, these factors can be mitigated, but at the expense of device brightness. Initial results show that pulsing the input voltage increases the lifetime of the OLED by up to an order of magnitude under certain driving conditions. The increase in lifetime is inversely dependent on the pulse frequency and pulse width. In order to increase the usable lifetime of these organic devices, an optimized driving scheme, in combination with additional design elements, such as thin-film encapsulation, is required. This project is supported by the Department of the Navy through eMagin Corporation.