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Characterizing Heat Spreading and Performance Degradation in Organic Light-Emitting Diodes AMELIA PLUNK, Mount Holyoke College, ANDREW DAVIS, University of Massachusetts Amherst, KADHAIR AL-HEMYARI, ALEXI ARANGO, Mount Holyoke College, KENNETH CARTER, University of Massachusetts Amherst, JANICE HUDGINGS, Mount Holyoke College — In this work, we present for the first time high resolution thermal images of operating organic light-emitting diodes (OLEDs) and show that the surface temperature of these devices can be used to map current density and identify the origin of localized defects and performance degradation. Both luminance and lifetime of OLEDs decrease dramatically with increased operating temperature due to self-heating. Furthermore, localized Joule heating at defects results in local hot spots, thus degrading the brightness homogeneity, altering the electro-optical characteristics of the OLED, and leading to electrode delamination and black spots. Increasing the lifetime of OLEDs clearly relies at least in part on improved thermal management. Using thermoreflectance microscopy, we observed evidence of the correlation between structural defects and areas of low current density by examining areas of operating devices which showed visual damage and had a low relative surface temperature. We also show the validity of using thermoreflectance microscopy to perform basic characterization of operating OLEDs, such as examining diode behavior, extrapolating material qualities such as diffusivity and conductivity, and quantifying the heat flow through working devices.

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