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IfP
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Organic Memory Elements

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Photochromic molecules provide an intriguing and relatively untapped alternative to traditional materials utilized in organic memory devices. We have recently reported on a new prototype of a nonvolatile light-emitting organic memory (LE-OMEM) that integrates a layer of crosslinkable dithienylethene photochromes (XDTE) into a solution-processed, multilayer OLED. The XDTE molecules undergo a change in both their UV-visible absorption and energy level position due to a photo- and/or electrically-induced ring-opening/-closing reaction. Exploiting the difference in HOMO and LUMO energies of both isomers and the subsequent change in hole-injection barrier we use this XDTE layer as an electrical switch within our OLED layer stack. Optimized devices have displayed ON/OFF ratios in both current and electroluminescence of greater than 104. We investigate both optical and electrical programming of the OMEM devices and show that precise control of the ratio of both isomers in the active layer enables access to a multitude of intermediate states demonstrating the potential of these devices for future multilevel memory applications. We also discuss the difference in the molecular-scale mechanisms that are responsible for the optically- and electrically-induced switching effect in these devices by in-situ monitoring of the fraction of closed molecules as a function of the external stimulus.