

Operational Stability Behavior Tailored by Gate Dielectric Polymers in Organic Transistors

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Charge traps in polymer gate dielectrics determine the electrical stability of OFETs and polar alkoxy groups are well-known extrinsic charge traps. However, the actual location of intrinsic charge traps in nonpolar polymer gate dielectrics has been poorly understood yet. Here, we demonstrate that the polymer free volume provides intrinsic charge trap sites related to electrical stability. To verify it, we prepared linear and branched polystyrene (l-PS and b-PS), and blended them, in which branched segments provide much larger free volume than the other segments. The current-insulating performance and field-effect mobility increased with decrease of b-PS portion. In particular, the bias-stress stability was remarkably varied according to the change of b-PS portion even though all measurements excluded reactive components such as oxygen and water; the increase of b-PS resulted in time-dependent decay of mobility and threshold voltage under bias stress. This indicates that the free volume around branched segments in b-PS provides intrinsic and metastable charge trap sites.