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Dependence of Mobility on Density of Gap States in Organics by GAMEaS - Gate Modulated Activation Energy Spectroscopy WOO-YOUNG SO, DAVID LANG, Columbia University, ARTHUR RAMIREZ¹, Alcatel-Lucent — We develop a spectroscopic method for determining the density of states (DOS) in the energy gap - Gate Modulated activation Energy Spectroscopy (GAMEaS), We also report the relationship of these gap states to the mobility of organic field-effect-transistors (FETs). We find that the field-effect mobility is parameterized by two factors: (1) the free-carrier mobility and (2) the ratio of the free carrier density to the total carrier density induced by the gate bias. We show that the highest mobility FETs have shallow exponential band tails of localized states with characteristic slope of $1/kT$ at 300K. Most remarkably, state-of-the-art crystalline FETs fabricated from rubrene, pentacene, and tetracene all have a very high free-carrier mobility, up to $200\text{cm}^2/\text{Vsec}$ at 300K, with the somewhat lower effective mobilities dominated by localized gap states. This strongly suggests that further improvements in device performance could be possible with enhanced material quality.

¹Columbia University

Woo-young So
Columbia University

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