Charge Transport Simulations for Amorphous Organic Thin Film Devices CONOR MADIGAN, VLADIMIR BULOVIC, EECS, MIT, Cambridge, MA — We employ Monte Carlo simulations to analyze charge transport through amorphous organic thin films using the well-established "Miller-Abrahams" hopping model within a disordered manifold of molecular energies. Whereas most existing studies calculate non-dispersive, equilibrium mobilities at low carrier concentrations, in this work we instead calculate current densities for film thicknesses (i.e. 10 to 100 nm) and applied voltages (i.e. 0.1 to 100 V) typical of common thin film devices (e.g. organic light emitting devices and photovoltaics). We find that at these thicknesses one can not assume the non-dispersive, equilibrium condition. Also, since conduction typically occurs at high carrier concentrations and is space charge limited, we must employ simulations which treat both conditions. We compare our results with those predicted by existing analytic theories, and find that the analytic theories are often highly inaccurate, mainly due to faulty use of Fermi statistics and improper calculation of backward hopping.

Conor Madigan
EECS, MIT, Cambridge, MA

Date submitted: 12 Jan 2006   Electronic form version 1.4