Supporting information for:

Simulating Charge Injection and Dynamics in Micro-scale Organic Field-Effect Transistors

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Figure S1A shows the average lifetime as a function of device width for a constant device length of 384 nm including Coulomb interactions. The lifetime remains constant with device width except below 384 nm, where the lifetime becomes noticeably smaller. The same behavior is seen for the path length, shown in Figure S1B. The standard deviation of the data, shown by the error bars or seen visually in the histograms shown in Figure S2, also does not change significantly with device width.

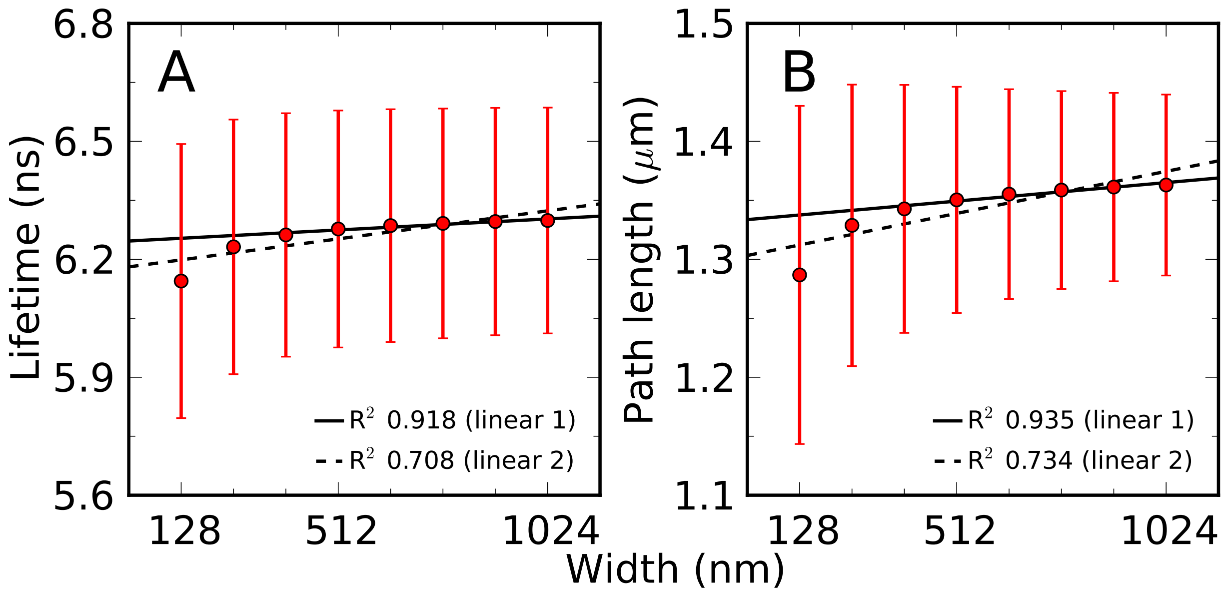

Figure S1: (A) shows the average carrier path length as a function of device width, and (B) shows the average carrier lifetime as a function of device width. Both keep a constant device length of 512 nm. The red circles represent averages while error bars reflect the standard deviation of the data. The dashed line is a linear fit of all points, while the solid line is a linear fit excluding the smallest two widths.

Figure S2 shows histograms of path length and lifetime for a 512 by 512 nm device with and without Coulomb interactions. Regardless of Coulomb interactions, the lifetime takes a Gaussian shape and similar values. For the case shown, the maximum is only 0.95% smaller when including Coulomb interactions. The path length maximum, however, is 13.0% smaller when including Coulomb interactions. Additionally, the shape is non-Gaussian, with a tail towards low path length when including Coulomb interactions. The result is independent of the seeding or injection procedure. Changing the device length changes the location of the maximum - see Figure 5 in the main text.

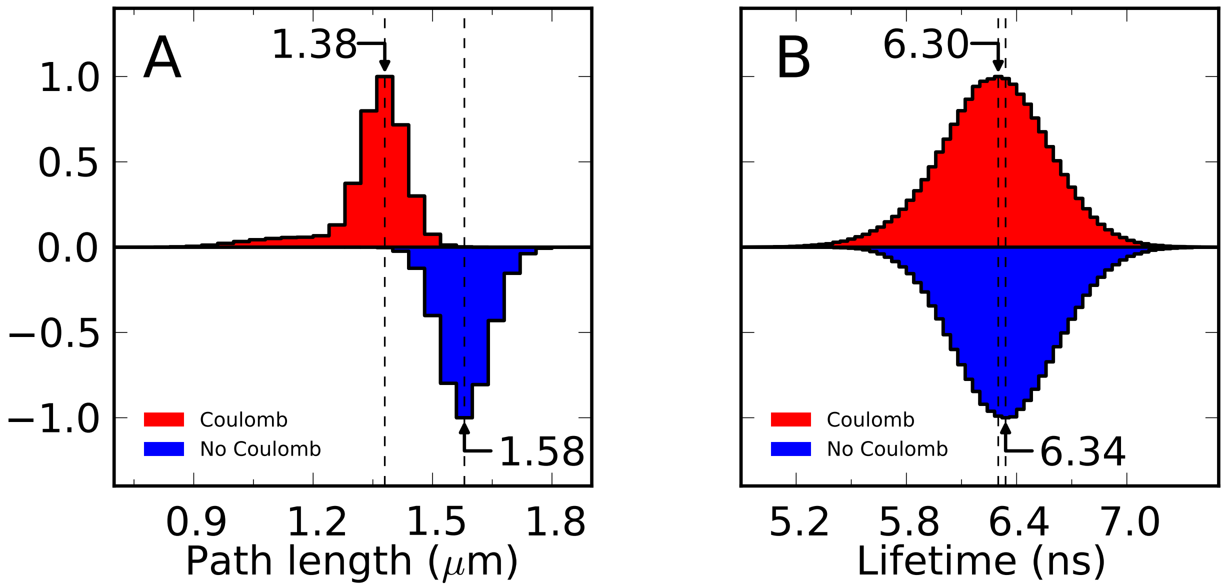

Figure S2: (A) shows histograms of carrier path length, and (B) shows histograms of carrier lifetime. The system shown was 512 by 512 nm. The data was collected for 2 μs. The red histogram (above zero line) includes Coulomb interactions, while the blue histogram (below zero line) does not.

Figure S3 shows the Coulomb potential at every location in a 256 by 256 nm device. Figure S4 shows a linescan of this potential taken at $y = 128$ nm. While the system has reached the desired concentration and an equilibrated state, the carriers are not distributed isotropically. There is a depletion region near the drain electrode (right). Also, the majority of carriers are traveling paths in the central region of the device because they are being repelled by other carriers lining the surface.

Figure S5 shows Fourier transforms of instantaneous current for geometries with heights and widths in the range 128 nm to 384 nm. Notice that the peak locations shift to lower frequency with increasing device length, but do not change with device height.

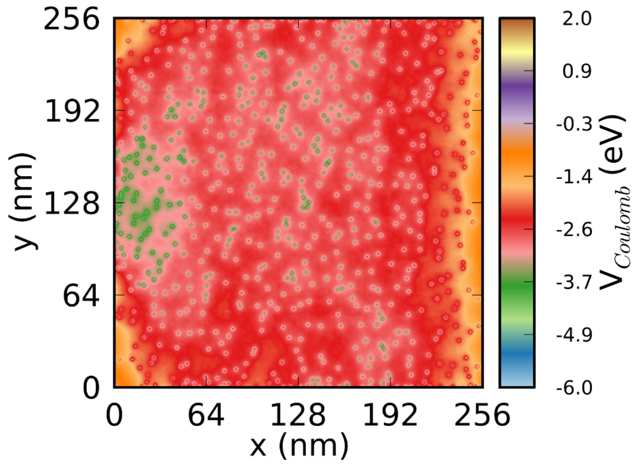

Figure S3: A contour plot of the Coulomb potential due to carriers for a 256 by 256 nm device.

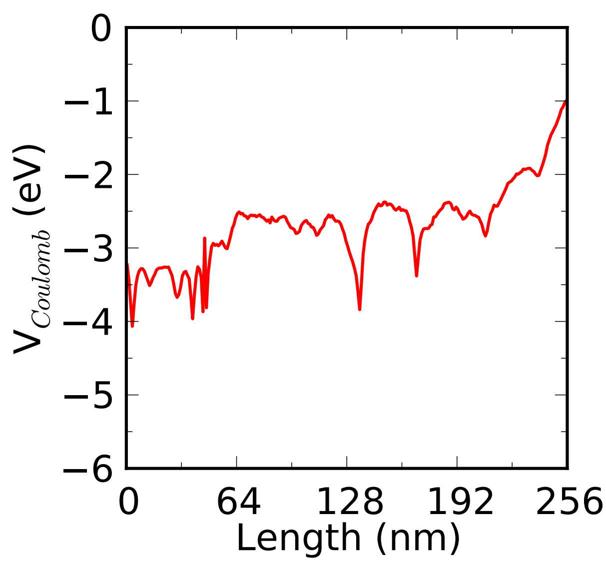

Figure S4: A linescan of the same Coulomb potential shown in Figure S3, taken at y = 128 nm, midway through the grid.

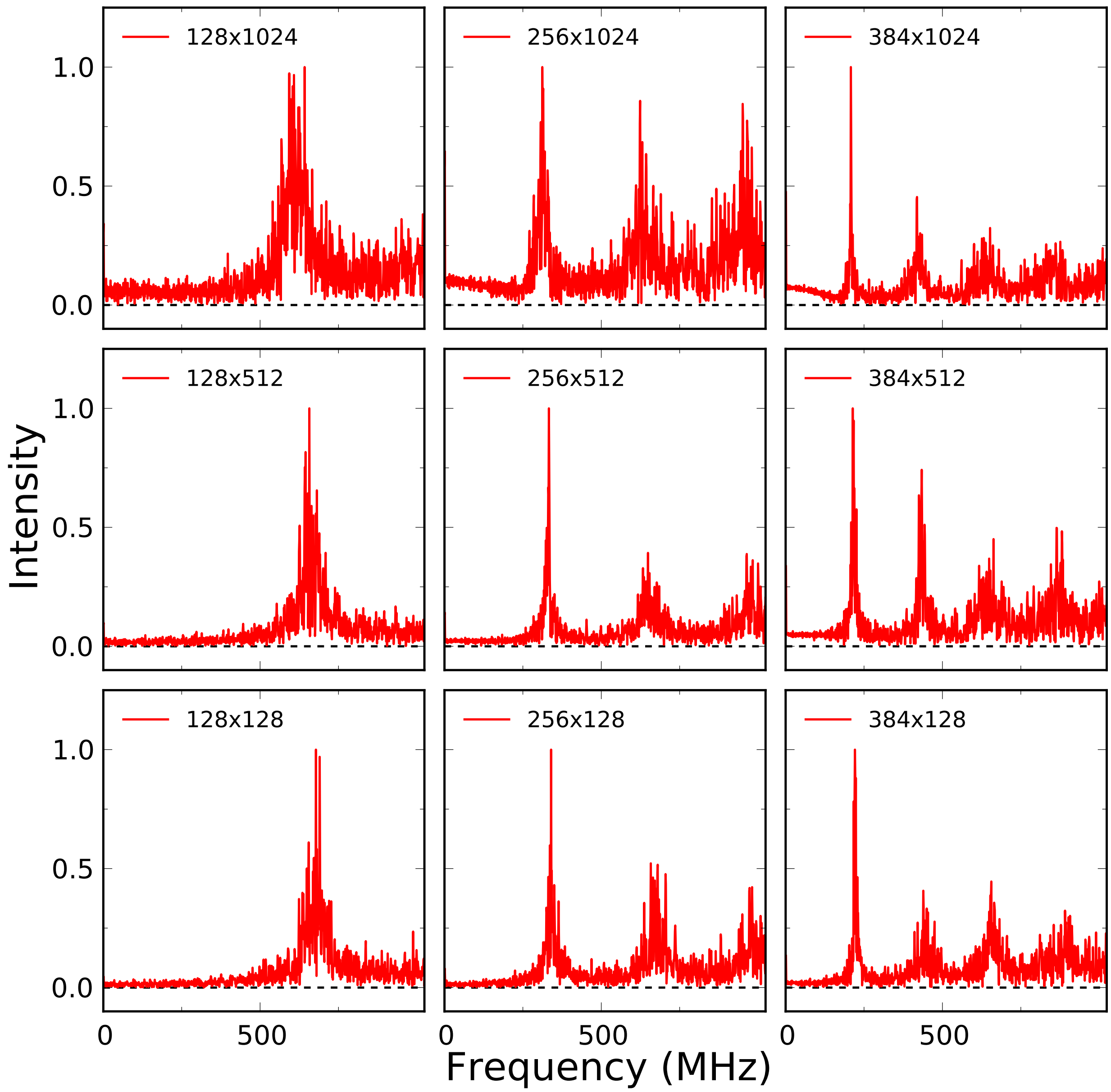

Figure S5: Fourier transform power spectra for various device geometries. The device dimensions (length by height) are shown in the upper left corner of each spectrum.