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Conductivity Maxima on the Surface of Organic Semiconductor Crystals at High Charge Densities[1] WEI XIE, C. DANIEL FRISBIE, Department of Chemical Engineering and Materials Science, University of Minnesota — We have previously achieved effective carrier mobility up to 3.2 $cm^2V^{-1}s^{-1}$ at charge densities larger than 10^{13} cm^{-2} in rubrene electrical double layer transistors (EDLTs) gated with ionic liquids (ILs). At lower temperatures when a larger gate bias can be applied, the maximum attainable charge density reaches $6.5*10^{13}$ cm^{-2} (0.34 holes per rubrene molecule), and more remarkably, two pronounced maxima in channel conductivity have been reproducibly and stably observed. This feature, which has not been reported for any EDLTs gated with electrolytes, is independent of ionic liquid composition, current-voltage sweep rate, and crystallographic directions of rubrene crystals. We have identified that the first and second conductivity peaks occur at charge densities of $2.0*10^{13}$ cm^{-2} and $5.2*10^{13}$ cm^{-2}, respectively. Capacitance-voltage (C-V) measurements at different frequencies have also revealed two maxima at the same gate voltages as in current-voltage measurements. Collectively, these observations imply that the conductivity maxima at high charge densities are very likely related to the electronic band structure on the surface of rubrene crystals.

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