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High Carrier Density and High Hole Mobilities of Ion Gel Gated Polymer Thin-Film Transistors JIYOUL LEE, C. DANIEL FRISBIE[1], Department of Chemical Engineering and Materials Science, University of Minnesota, TIMOTHY P. LODGE, Departments of Chemistry and Chemical Engineering and Materials Science, University of Minnesota — We report the comprehensive characterization of ion gel gated polymer thin-film transistors (IG-PTFTs), in which PQT-12 was used as the active layer and an ion gel comprising a polymer network swollen with an ionic liquid was used as the gate dielectric. The high capacitance of ion gels (>10 μF/cm2) can induce a very large hole density ($\sim$ 2 x 10^{14} charges/cm^2) in the channel of polymer semiconductor layers in IG-PTFTs, leading to low operation voltages, high hole mobilities of $>$ 1 cm^2/Vs, and high ON currents. High ionic conductivities of ion gels ($>$ 1 mS/cm) enable fast response time ($\sim$ 1.5 ms at 80 % ON/OFF) of IG-PTFTs. Temperature dependent measurements were carried out with IG-PTFTs. In the high temperature range (310 K $\sim$ 360 K), the device showed faster response time and little hysteresis due to increasing ionic conductivity with the operating temperature. At low temperature (20 K $\sim$ 185 K) where the ions are immobile, high ON currents between source and drain can be maintained with weak temperature dependence. Overall, the results demonstrate that the IG-PTFTs offer opportunities to probe transport of high 2-D charge carrier densities in semiconductors.

[1]Corresponding Author

Jiyoul Lee
Department of Chemical Engineering and Materials Science,
University of Minnesota, 421 Washington Avenue SE, Minneapolis, Minnesota 55455

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